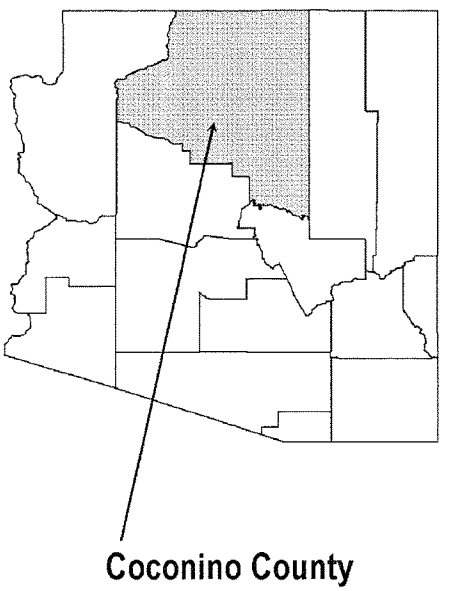
FLOOD INSURANCE STUDY

VOLUME 1 OF 2

COCONINO COUNTY, ARIZONA
AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
COCONINO COUNTY (UNINCORPORATED AREAS)	040019
FLAGSTAFF, CITY OF	040020
FREDONIA, TOWN OF	040021
HAVASUPAI INDIAN RESERVATION	040023
PAGE, CITY OF	040113
SEDONA, CITY OF	040130
WILLIAMS, CITY OF	040027



SEPTEMBER 3, 2010

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
04005CV001A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: September 3, 2010

Revised Countywide FIS Date:

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EXHIBITS - continued

FLOOD INSURANCE STUDY
COCONINO COUNTY, ARIZONA AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) investigates the existence and severity of flood hazards in, or revises and updates previous FISs/Flood Insurance Rate Maps (FIRMs) for the geographic area of Coconino County, Arizona, including the Cities of Flagstaff, Page, Sedona, and Williams, Town of Fredonia, Havasupai Indian Reservation and the unincorporated areas of Coconino County (hereinafter referred to collectively as Coconino County). The City of Sedona, which is located in Coconino and Yavapai Counties, was previously shown in its entirety on the Yavapai County and Incorporated Areas FIRM. However, the City of Sedona has elected to be shown on both the Coconino and Yavapai Countywide FIRMs. Only the portion of the City of Sedona that lies within Coconino County will be shown on the Coconino County and Incorporated Areas FIRM. The remaining portion that lies in Yavapai County will be shown on the Yavapai County and Incorporated Areas FIRM. The Hopi, Hulalapai, and Kaibab Indian Reservations and the Navajo Nation, are part of the unincorporated areas of Coconino County.

This FIS aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This FIS has developed flood risk data for various areas of the county that will be used to establish actuarial flood insurance rates. This information will also be used by Coconino County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and will also be used by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This FIS was prepared to include the unincorporated areas of, and incorporated communities within, Coconino County in a countywide format. Information on the authority and acknowledgments for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below.

Coconino County

(Unincorporated Areas): the hydrologic and hydraulic analyses from the FIS report dated November 16, 1983, were performed by PRC Toups, for the Federal Emergency Management Agency (FEMA), under Contract No. H-4700. That work, which was completed in January 1981 for the City of Flagstaff and in March 1981 for the City of Williams, Town of Fredonia and Coconino County, covered all significant flooding sources affecting these communities.

The hydrologic analysis from the FIS report dated September 30, 1988, was performed by Landmark Engineering & Surveying, Inc. The restudy was based on more detailed topographic information for the right overbank of Oak Creek.

The hydraulic analysis from the FIS report dated September 28, 1990, was performed by the United States Army Corps of Engineers (USACE), Los Angeles District, as part of the Limited Map Maintenance Program (LMMP) for the City of Flagstaff.

The hydrologic and hydraulic analyses from the FIS report dated March 2, 1993, were performed by the U.S. Geological Survey (USGS), Tempe, Arizona, under Interagency Agreement No. EMW-89-E-2997.

The hydraulic analyses from the FIS report dated December 17, 1993, was performed by Water Engineering & Technology (WET).

The hydraulic analyses were developed for the FIS dated September 30, 1995 for Fanning Drive Wash and Penstock Avenue Wash based on updated cross-section data.

Flagstaff, City of: the hydrologic and hydraulic analyses for the FIS report dated January 19, 1983, were performed by PRC Toups Corporation, for FEMA, under Contract No. H-4700. That work, which was completed in January 1981, covered all significant flooding sources affecting the City of Flagstaff.

The hydraulic analyses from the September 28, 1990 FIS report revision were performed by the

USACE, Los Angeles District, under FEMA's LMMP, Interagency Agreement No. EMW-88-E-2768, Project Order No. 8A. That work was completed in January 1989.

The hydraulic analyses were developed for the FIS dated September 30, 1995 for Fanning Drive Wash and Penstock Avenue Wash based on updated cross-section data.

The hydraulic analyses from the August 2, 1996 FIS report revision, were performed by the City of Flagstaff for FEMA, and the results are presented in a report entitled "City of Flagstaff, Engineering Division, Stormwater Management Section, Clay Avenue Wash Flood Study," and dated March 1, 1995. This work was completed on March 1, 1995.

Fredonia, Town of: the hydrologic and hydraulic analyses for the November 17, 1981, study, were performed by PRC Toups, for FEMA, under Contract No. H-4700. That work, which was completed in March 1981, covered all significant flooding sources affecting the Town of Fredonia.

Sedona, City of: the City of Sedona was incorporated from land areas in Yavapai and Coconino Counties on January 4, 1988.

The hydrologic and hydraulic analyses for Soldier Wash and for that portion of Oak Creek that flows through Coconino County were performed by PRC Toups for FEMA under Contract No. H-4700. That work, which was completed in 1981, covered all significant flooding sources affecting the City of Sedona in Coconino County.

Williams, City of: the hydrologic and hydraulic analyses for the June 15, 1983, study were performed by PRC Toups Corporation for FEMA under Contract No. H-4700. That work, which was completed in March 1981, covered all significant flooding sources affecting the City of Williams.

The authority and acknowledgments for the Havasupai Indian Reservation or the City of Page are not available because no FIS reports were ever published for those communities.

For this countywide FIS revision, updated detailed hydrologic and hydraulic analyses for Peak View Wash and Schultz Creek along with reaches of the Rio de Flag, Switzer Canyon Wash, and Bow and Arrow Wash. Entellus, Inc. (the study contractor) completed the hydrologic and hydraulic analyses for FEMA, under Contract No. EMF-1999-CO-0057 in April 2004. MAPIX-Mainland developed floodplains behind non-levee embankments which were shown as providing protection on the previous FIRMs under Contract No. EMT-2003-CO-0047 in April 2008. Finally, MAPIX-Mainland developed updated hydrologic and hydraulic analyses for a reach of the Rio de Flag for FEMA under Contract No. EMF-2003-CO-0047 in December 2008. MAPIX-Mainland compiled the above mentioned analyses for FEMA into digital format, under Contract No. EMF-2003-CO-0047. MAPIX-Mainland completed this work in April 2009.

Base map information shown on this FIRM was derived from USGS Digital Orthophoto Quadrangles produced at a scale of 1:12,000 from photography dated 1992 or later.

The coordinate system used for the production of the countywide FIRM is Universal Transverse Mercator (UTM), North American Datum of 1983 (NAD 83), GRS 80 spheroid. Corner coordinates shown on the FIRM are in latitude and longitude referenced to the UTM projection, NAD 83. Differences in the datum and spheroid used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on the FIRM.

1.3 Coordination

Consultation Coordination Officer's (CCO) meetings may be held for each jurisdiction in this countywide FIS. An initial CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to review the results of the study.

The dates of the initial and final CCO meetings held for Coconino County and the incorporated communities within its boundaries are shown in Table 1, "Initial, Intermediate, and Final CCO Meetings."

TABLE 1 – INITIAL, INTERMEDIATE, AND FINAL CCO MEETINGS

Community	For FIS Dated	Initial CCO Date	Intermediate CCO Date	Final CCO Date
Coconino County (Unincorporated Areas)	November 16, 1983	April 4, 1978	*	August 13, 1980
	September 30, 1988	*	*	*
	September 28, 1990	*	*	*
	March 2, 1993	*	December 11, 1990	April 13, 1992
	December 17, 1993	*	*	*
	September 10, 1995	*	*	November 1, 1994
Flagstaff, City of	January 19, 1983	April 3, 1978	*	August 12, 1980
	September 28, 1990	*	*	November 14, 1989
	September 30, 1995	*	*	November 1, 1994
	August 2, 1996	*	*	*
Fredonia, Town of	November 17, 1981	April 5, 1978	*	May 5, 1981
Sedona, City of	*	April 4, 1978	*	August 13, 1980
Williams, City of	June 15, 1983	April 4, 1978	*	August 12, 1980

*Data not available

For this countywide FIS, final CCO meetings were held May 6, 2009. These meetings were attended by representatives of the study contractors, the communities, the State of Arizona, FEMA, and MAPIX Mainland.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Coconino County, Arizona.

All or portions of the flooding sources listed in Table 2, "Flooding Sources Studied by Detailed Methods," were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

TABLE 2 - FLOODING SOURCES STUDIED BY DETAILED METHODS

Baderville Tributary to Rio de Flag
Mormon Lake Sinclair Wash
Bow and Arrow Wash
Munds Canyon Creek
Soldier Wash
Cataract Creek
Munds Park Wash
Spruce Avenue Wash
Cataract Creek Tributary
Oak Creek
Switzer Canyon Wash
Cemetary Wash
Peaceful Valley Wash
Stoneman Lake
Clay Avenue Wash
Peak View Wash
Switzer Canyon Wash
Clay Avenue Wash Split Flow
Penstock Avenue Wash
Tributary 1 to Baderville Tributary
Country Club Wash
Rio de Flag
Tributary 2 to Baderville Tributary
Detention Basin
Rio de Flag Split Flow
Unnamed Wash
Fanning Drive Wash
Santa Fe Wash East
West Street Wash
Howard Draw Wash
Santa Fe Wash West
Kanab Creek
Schultz Creek

For this countywide the following reaches of riverine flooding were restudied by detailed methods:

Bow and Arrow Wash – From the South Lone Tree Road crossing to approximately 1,800 feet upstream of Lake Mary Road.

Peak View Wash – From approximately 130 feet downstream of Cooper Drive, to approximately 120 feet upstream of Lois Lane.

Rio de Flag – From the Rio Ranch Road crossing to Route 66, and from the Narrows Dam to approximately 500 feet downstream of the Hidden Hollow Road crossing.

Schultz Creek – From approximately 2,000 feet downstream of the Fort Valley Road crossing, to the Shultz Pass Road crossing.

Switzer Canyon Wash – From the East Route 66 crossing to approximately 2,800 feet upstream of the San Francisco Street crossing.

This FIS also incorporates the determinations of letters issued by FEMA resulting in map changes (Letter of Map Revision [LOMR], Letter of Map Revision - based on Fill [LOMR-F], and Letter of Map Amendment [LOMA], as shown in Table 3, "Letters of Map Change."

TABLE 3 - LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type
City of Flagstaff	Fourth Street Railroad Crossing	November 28, 2008	LOMR
Unincorporated Areas	Tiaquepaque	May 19, 2008	LOMR
Unincorporated Areas	Majestic View	September 27, 2007	LOMR
City of Williams and Unincorporated Areas	Cataract Creek Estates	May 31, 2007	LOMR
City of Williams	Grand Canyon Railway, Cataract Creek Channelization	March 29, 2007	LOMR
City of Flagstaff	Fanning Drive Wash	March 16, 2006	LOMR
City of Flagstaff and Unincorporated Areas	Switzer Canyon Wash Realignment	January 18, 2006	LOMR
City of Flagstaff	Foxglenn Development	September 15, 2005	LOMR
Unincorporated Areas	The Cliffs at Oak Creek	January 30, 2003	LOMR
City of Flagstaff and Unincorporated Areas	West Village Commercial Development	September 25, 2002	LOMR
City of Flagstaff	Ponderosa Trails	January 04, 2001	LOMR
City of Flagstaff	Timberline Village 2	June 04, 1999	LOMR
City of Flagstaff	Boulder Ridge Villas	March 17, 1999	LOMR
City of Flagstaff	Spruce Avenue Wash Storm Drain	March 17, 1999	LOMR
City of Flagstaff	Hampton Inn	October 08, 1996	LOMR
City of Flagstaff	Spruce Avenue Wash Storm Drain	August 15, 1996	LOMR
City of Flagstaff	Walnut Meadow Subdivision	April 22, 1996	LOMR
City of Flagstaff	Woodlands Village Unit 3, Lot 34	August 17, 1995	LOMR
City of Flagstaff	Spruce Avenue Wash Storm Drain	August 16, 1995	LOMR
City of Flagstaff	Sinclair Wash	June 19, 1995	LOMR
City of Flagstaff	Walnut Canyon Lake	April 04, 1991	LOMR

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

All or portions of numerous flooding sources in the county were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and Coconino County.

2.2 Community Description

Coconino County is located in north-central Arizona. It is surrounded by Kane and San Juan Counties, Utah, to the north, Navajo County to the east, Gila and Yavapai Counties to the south, and Mohave County to the west. Coconino County is the largest county in Arizona.

The majority of development within Coconino County is centered around the incorporated City of Flagstaff which is located in the southern portion of the county. Other centers of development include the incorporated City of Williams and the Town of Fredonia which are located in the southwest and northwest portions of the county, respectively. According to the Bureau of the Census, the 2000 population of Coconino County was 116,320. The population in 2006 increased to an estimated 124,953.

Cataract Creek, the major wash running through the City of Williams, originates in the mountains south of the City of Williams. Several small reservoirs in the City of Williams are fed by Cataract Creek and Cataract Creek Tributary. Cataract Creek flows through a medium-populated residential area, a commercial area, and a lightly populated residential area as it flows through the City of Williams. Santa Fe Wash East and Santa Fe Wash West are tributaries to Cataract Creek which originate in the mountains south of the City of Williams and flow through more sparsely populated areas than Cataract Creek.

Howard Draw Wash flows into the west side of Lower Lake Mary in a northeasterly direction. The elevation of the study area is approximately 6,803 feet NAVD. The floodplains of Howard Draw Wash have light residential development.

Munds Park Wash flows through the unincorporated community of Munds Park. Munds Park is located approximately 18 miles south of the City of Flagstaff along Interstate Highway 17. Light residential development occurs along Munds Park Wash in the form of summer homes and condominiums in this retirement-resort community.

The Oak Creek study area starts at the southwest corner of Coconino County in the City of Sedona and proceeds upstream in a northerly direction towards the City of Flagstaff. The City of Sedona is located approximately 27 miles south of the City of Flagstaff. The City of Sedona is at an elevation of 4,300 feet and has an average total precipitation of 17.2 inches per year with an average snowfall of 9.0 inches per year. A significant percentage of the population is made up of retired people; however, the community of the City of Sedona, including the Village of Oak Creek, is growing rapidly, requiring an active construction industry. The construction industry and the recreational attractions of Oak Creek provide the major source of employment in the City of Sedona area.

Oak Creek has formed a significant canyon over the years. A floodplain does not exist in some areas due to the deep and narrow channels that the flow has formed. In other areas where floodplains exist, the canyon walls serve to confine the usable land and, therefore, concentrate any development along Oak Creek and its tributaries. Soldier Wash and Munds Canyon are tributaries to Oak Creek. Solider Wash flows through the City of Sedona and has medium residential development along it. Munds Canyon flows into Oak Creek upstream of the City of Sedona and has light residential development along it.

Rio de Flag is a tributary of San Francisco Wash, which flows into Little Colorado River. Rio de Flag originates on the southwestern slopes of the San Francisco Mountains north of the City of Flagstaff. In the study area, Rio de Flag flows through various types of terrain including wide, flat valleys with little relief, steep, narrow canyons; and relatively wide, flat-bottomed canyons. It is on the broad floodplains of Rio de Flag that growing residential development occurs. Commercial development is sparse as most residents work in the City of Flagstaff.

Mean annual precipitation for the basin ranges from approximately 20 inches near the City of Flagstaff to approximately 35 inches on the San Francisco Mountains. The annual basin average is approximately 25 inches. The elevations of the study areas range from 6,500 to 7,400 feet.

Vegetation in the Rio de Flag drainage basin consists primarily of pinon and ponderosa pines, oaks, and junipers at lower elevations. At higher elevations, fir, spruce, and aspen trees are common. Ground cover on the mountain slopes is relatively sparse, but, in the flat valleys, grasses and shrubs are abundant (USACE, 1975).

The Rio de Flag drainage basin is located in an area of past volcanic activity and, therefore, a significant portion of the drainage area is made up of a cindery soil. The steeper sloping areas at higher elevations are generally classified by the U.S. Soil Conservation Service as Type B or C soils. The more gently sloping areas at lower elevations are generally classified as Type C or D soils.

Sinclair Wash is the major tributary to Rio de Flag, originating southwest of the City of Flagstaff on the slopes of Woody Mountain. Sinclair Wash flows generally northeasterly to its confluence with Rio de Flag within the City of Flagstaff corporate limits. Other smaller tributaries to Rio de Flag within the county are Fanning Drive Wash, Switzer Canyon Wash, and Clay Avenue Wash.

Mormon Lake and Stoneman Lake are located approximately 22 miles and 30 miles south-southeast of the City of Flagstaff. Both lakes were formed by nature. Stoneman Lake was formed in the crater of an extinct volcano, and Mormon Lake was probably formed by the shifting of the earth along a fault line. The natural overflows of these lakes are high above their normal water-surface elevations. The water levels of these lakes are determined by the balance between rainfall and runoff into the lakes, and infiltration and evaporation out of the lakes. The unincorporated area around these lakes is sparsely populated; however, development is growing in the form of summer homes.

The Town of Fredonia is at an elevation of approximately 4,600 feet and is located on an arid to semi-arid basin. The mean annual precipitation is 9.8 inches in the Town of Fredonia. Kanab Creek flows southerly along the western corporate limits of the Town of Fredonia. The soils consist of silty material and are highly erosive. There is little vegetation other than some shrubs and trees. Light residential development exists along the eastern floodplain of Kanab Creek in the Town of Fredonia.

The City of Sedona is located in the northeastern portion of Yavapai County and the adjacent portion of Coconino County. It is approximately 27 miles south of the City of Flagstaff. It is entirely surrounded by Coconino National Forest (Desert USA, 1999). The City of Sedona is at an average elevation of 4,300 feet and has an average total precipitation of 17.2 inches per year with an average snowfall of nine inches per year.

The City of Williams is located in southwest Coconino County, approximately 150 miles north of Phoenix. The city is enclosed by Kaibab National Forest and is approximately 60 miles south of Grand Canyon National Park. Tourists visiting those natural attractions provide an important source of income to area residents.

2.3 Principal Flood Problems

Significant flooding occurred in the upper reaches of the Rio de Flag in December 2004 affecting the unincorporated community of Fort Valley. Additionally, significant floodflows occurred on Rio de Flag in the following years: 1888, 1896, 1903, 1905, 1916, 1920, 1923, 1937, 1938, 1950, 1963, 1966, and 1973. Although some documentation exists for these floods, the descriptions are limited to flooding within the City of Flagstaff. Due to light development in these areas at that time, damages were probably limited to erosion and loss of land.

Flooding has occurred on Howard Draw Wash in 1993, 1995, and 2004 affecting the subdivisions of Lake Mary Park and Lake Mary Meadows. High-water elevations on Lower Lake Mary in May 1980 ponded into the lower areas of Howard Draw Wash, inundating some roads and driveways, and making access difficult to some homes.

History of flooding in the Munds Park Wash area is limited. However, as recently as December 2004, the golf course at Pinewood Country Club and adjacent residences were inundated by significant flooding. Flooding in 1979 at the Mormon Lake Road crossing spread to the west and caused shallow flooding in a small development before returning to Odell Lake. The Mormon Lake Road crossing has been changed from a dip section to a bridge, thus changing the potential for flooding at this site. Also, during flooding in 1979, the spillway on Odell Lake was washed out, causing flooding of the sparsely populated golf course area downstream. This spillway was rebuilt after the flooding in 1979.

History of water-surface elevations and flooding from Mormon and Stoneman Lakes indicates a wide range of water levels.

Mormon Lake has been dry on numerous occasions through the years. In 1927, a peninsula on the southwest corner of Mormon Lake became an island due to high water. The saddle of this peninsula has been checked to be an approximate elevation of 7,118 feet NAVD. This was the highest water level ever reached according to long-time residents of the area. The water level has fluctuated between these extremes through the years, with USGS topographic maps (U.S. Department of the Interior, 1965) giving an elevation of 7,110 feet NAVD for the

lake. Flood damages due to high water levels appear to have been slight in the past on Mormon Lake.

Stoneman Lake has also been dry or near dry on numerous occasions through its history. According to long-time residents of the area, the lake was at a record high elevation in the spring of 1980. The level was recorded at 6,733.4 feet NAVD on May 2, 1980. The lake level rose slightly after that. The USGS topographic maps (U.S. Department of the Interior, 1965) report a water-surface elevation of 6,720 feet NAVD for the lake. Flood damages on Stoneman Lake have been in the form of inundation of land.

The past history of flooding within the City of Flagstaff indicates that flooding may occur during any season of the year. Three types of storms produce precipitation in the area: general winter storms, general summer storms, and local storms. Summer storms normally are high-intensity, short-duration local storms, but severe, general summer storms, usually associated with tropical cyclones, also occur. General winter storms cover large areas and are usually of long duration. Their intensities are normally light to moderate.

Because climatic and drainage area characteristics are not conducive to continuous runoff, streamflow only occurs during and after rainfall and during periods of snowmelt. In areas of high permeability, as in the northern part of the drainage basin, little runoff occurs even from heavy rains.

The following is a list of descriptions of known floods. The sources of these descriptions are newspaper accounts, railroad records, museum publications, U.S. Soil Conservation Service reports, and Flagstaff city officials (USACE, 1975).

November 1888	Flood was caused by intense rainfall of less than 1-day duration. It was during this flood that the "Bottomless Pits" opened up on the surface. A newspaper article in 1903 calls 1888 the largest flood to have occurred. Water extended from old Hotel Weatherford to the school and was said to be "deep enough for a horse to swim." There may have been another flood, equally serious, in August 1888.
July 1896	Following heavy rain of short duration, the river overflowed its banks in many places within the City of Flagstaff, finding its old channel where the stream enters the city. South of the city, flat areas were covered with water.
April 1903	Melting snow and falling rain caused the river to overflow its banks and take its former course through the City of Flagstaff. When the river reached its highest stage, that portion of the city lying between Leroux and Sitgreaves Streets, in the flat part of the city just north of the railroad tracks, was under 1 to 15 inches of water. The area of Coconino County south of the tracks and west of the stream

was flooded. Since 1896, the river has had little water flowing in it.

November 1905 — There was no mention of flooding in November or any other time of the year. The month of November, however, was the wettest month on record, to 1905. It rained 7.10 inches, which is 4.88 inches above average for the month of November. U.S. Weather Bureau records indicate 3.91 inches of rain fell between November 11 and November 27.

January 1916 — Several days of snow and rain caused the river to run full, threatening to overflow in places. However, a freezing period retarded runoff from snowmelt enough to prevent damage. There had never been such a snowfall followed by steady rains, according to the oldest resident. The U.S. Weather Bureau measured 54 inches of snow in January, with an estimated 12 inches total water equivalent of snow and rainfall.

February 1920 — A 3-day rain, falling on already saturated soil, resulted in flooding not equaled in the previous 25 years. The river overflowed its banks and converted the area south of the city into a sizable lake. In the Bottomless Pits area, water was said to be 30 feet deep, but this was probably an exaggeration. Railroad records give a high-water elevation of 6,765.3 feet NAVD, indicating a depth of approximately 19 feet. Flow in the Bottomless Pits area was augmented by runoff from Slaughter House, Switzer, and several other smaller canyons. Runoff could have been greater had it not snowed in Fort Valley. Precipitation in the City of Flagstaff was reported to be 1.85 inches.

September 1923 — Nearly 3 days of hard rain caused the river to overflow its banks and flood more than one-third of the city, forming a lake that covered almost all the south side and extended to the east for several miles. Railroad records give a higher water elevation in the Bottomless Pits area of 6,762 feet NAVD. Precipitation in the City of Flagstaff was reported to be 2.12 inches.

April 1937 — The river, through the city, was near or at channel capacity for several days because of melting snow. This was the first time since 1923 that floodwaters flowed into the Bottomless Pits. The water-surface elevation in the Bottomless Pits area is not known.

March 1938 — Continuous rain falling on melting snow forced the river far over its banks at some points, and floodwaters lapped the

floodbeams of several bridges. Much of the south side was under water.

March 1950 — Rain and snowmelt caused the river to flow bankfull from Park Lake to O'Leary Street. There was little, if any, overflow.

August 1963 — An intense thunderstorm occurred on August 2, dumping 1.71 inches on the City of Flagstaff in 1 hour. One-half inch is said to have fallen in 5 minutes. Although the river was approximately 3 feet deep just north of the railroad tracks and lacked some 2 feet of overflowing, serious local flooding occurred in the vicinity of Aspen and Beaver Streets.

March 1966 — Snowmelt flood. Elevation of high-water mark in Bottomless Pits area was 6,756 feet NAVD.

April 1973 — Snowmelt flood. The river flowed bank-full for several days. No overflow. High-water elevation of 6,754.8 feet NAVD was estimated by a consultant to the city. The USGS measured a peak of 235 cfs at their staff gage north of the city.

Reliable estimates of peak discharges or volumes in Rio de Flag are virtually nonexistent. The information available is in the form of general descriptions from newspapers, recollections of city officials and long-time residents, and data obtained from Burlington Northern & Santa Fe Railroad files. Table 4, "Floods of Record, Rio de Flag, at Santa Fe Avenue" indicates the years of known and possible floods along with the estimated magnitude of their peaks. The magnitudes were estimated by interpreting the gathered information and comparisons with channel cross sections or high-water marks. Estimated recurrence intervals were made by comparing the discharges from Section 3.1 of this FIS, on a Gumbel plot, with discharges from Table 4.

TABLE 4 – FLOODS OF RECORD, RIO DE FLAG, AT SANTA FE AVENUE

Date	Range of Estimated Discharge (cfs)	Estimated Recurrence Interval (Years)	Type of Precipitation
November 1888	600-700	20	Rainfall
July 1896	600-700	20	Rainfall
April 1903	600-700	20	Snowmelt-Rainfall
January 1916	250-500	15	Snowmelt-Rainfall
February 1920	600-700	20	Rainfall
September 1923	1,200	80	Rainfall
April 1937	250-500	15	Snowmelt
March 1938	600-700	20	Snowmelt-Rainfall

TABLE 4 – FLOODS OF RECORD, RIO DE FLAG, AT SANTA FE AVENUE - continued

Date	Range of Estimated Discharge (cfs)	Estimated Recurrence Interval (Years)	Type of Precipitation
March 1950	250-500	15	Snowmelt-Rainfall
August 1963	250-500	15	Rainfall
March 1966	250-500	15	Snowmelt
April 1973	250-500	15	Snowmelt

Flooding problems are aggravated by natural obstructions to floodflows including brush, trees, and other vegetation growing along the streambanks in the floodplain. These obstructions impede the flow of floodwaters, causing backwater and increased floodwater depths. Also, debris, such as brush, trees, and manmade objects, can be carried along by the floodwaters and possibly block bridge or culvert crossings. This debris is capable of causing a reduction in flow through the structure resulting in a higher backwater condition and increased floodwater depths.

Many of the study areas in the City of Flagstaff consist of a small-capacity channel with many crossings and heavily developed floodplains. In such places, floodwater easily exceeds the capacity of the main flow channel and overflows into the floodplains where it is further impeded by the heavy development.

In the Town of Fredonia, floods on Kanab Creek are caused by snowmelt and rain on snow during the spring, and heavy rains in July and August.

The first great flood on Kanab Creek to do appreciable damage occurred on July 29, 1883. It flooded all the farmlands and meadowlands in the canyon near Kanab, along with all the field crops south of the village, and scoured out a broad channel below the former valley floodplain. In 1884 and 1885, the flooding occurred daily for 3 or 4 weeks, continuing the erosion of the channel. As a result of these 3 years of floods, the streambed was cut down approximately 70 feet for a distance of 15 miles downstream of Kanab. Since 1886, the trenching action has continued, extending upward to the extreme headwaters of Kanab Creek and throughout its tributaries (U.S. Department of the Interior, 1974).

In 1890, an irrigation dam was built at the site of the present irrigation dam in the Town of Fredonia. That dam was washed away before it was completed. Another dam was completed in about 1892 and served until 1909. In that year, it was also washed away by a tremendous flood. The existing irrigation dam was completed a couple of years later (U.S. Department of the Interior, 1974). There is no documented history of flooding since 1909.

No recurrence interval of stage-discharge information for the Town of Fredonia have been established for the past floods. Recurrence intervals on past floods

have not been estimated because of the large amount of erosion and deposition associated with the flooding of this stream.

Significant flood events have affected several unincorporated communities in Coconino County in recent years, most notably 1993, 1995, and 2004. Affected communities include Fort Valley, Kachina Village, Mountain Dell, Pine Del, Munds Park, and Oak Creek Canyon.

In Coconino County, in the City of Sedona, Oak Creek has flooded many times in past years. Significant flood flows occurred in the following years as recorded at the USGS gage station at Cornville: 1885, 1938, 1952, 1956, 1964, 1967, 1969, 1970, 1976, 1978, 1979, 1980, 1993, 1995, and 2004.

In the flooding of 1980, the discharge measured at the Cornville gage station was 18,000 cubic feet per second (cfs) on February 15 and 25,000 cfs on February 19. These floods were estimated by the study contractor to have had approximately a 2-percent annual chance (50-year) recurrence interval in the vicinity of the City of Sedona.

Damage due to flooding has been mostly in the form of erosion and, therefore, loss of land.

The history of flooding in the City of Williams area indicates that constrictive hydraulic structures are a major contributing factor to flooding. Floodflows, backed up by constrictive hydraulic structures at road crossings, spread into the floodplain areas and in some instances flow overland into other washes. The overland floodflows are generally shallow, causing low-lying structures to be inundated by flows less than one foot deep.

The flood of December 1978 was caused by rainfall on the snow-covered mountains above the City of Williams. Floodflows on Cataract Creek backed up at 5th Street, causing weir flow over 5th Street. This flow went overland, crossing at 2nd Street and the Burlington Northern & Santa Fe Railway. Flow also broke out on Cataract Creek at Edison Avenue, causing shallow flooding east to 2nd Street. This flood was estimated to have been approximately a 75-year flood.

2.4 Flood Protection Measures

Several small dikes and riprapped embankments have been constructed by private landowners along Oak Creek in Coconino County to protect their property from inundation and erosion during floods.

A small, earth-filled dam creating Odell Lake exists on Munds Park Wash, but its effect in reducing potential flood damage is minimal.

A bridge has been built at the intersection of Mormon Lake Road and Munds Park Wash to replace a dip-section. This bridge will reduce flooding potential in a development southwest of the intersection.

A small dike was built along Stoneman Lake in 1956 by the SCS and a private landowner to protect a portion of the surrounding area from flooding. Although the dike was built to have 2-foot freeboard above the highest-known water level at that time, the dike is presently under water. No significant building damage occurred due to the overtopping of the dike.

City Park Reservoir south of the City of Williams was considered in the Coconino County FIS; however, due to the small size and storage capabilities of the dam, the flood protection provided by the dam is limited.

No significant floodplain management measures have been taken by Coconino County to regulate building in the floodplain.

No significant floodplain management measures have been used in the past to reduce potential flood damage in the City of Flagstaff.

Two flood protection structures exist in the Town of Fredonia. A berm parallels the east side of Kanab Creek from the irrigation dam upstream to around the area east of McKinney Street. This berm provides flood protection by containing the 1-percent annual chance flood to Kanab Creek, thereby minimizing flooding between U.S. Alternate Highway 89 and Kanab Creek below McKinney Street.

The second flood protection structure is the Flood Retarding Structure and Diversion Channel built by the U.S. Soil Conservation Service in the early 1970s northeast of town. The Flood Retarding Structure will retain the 1-percent annual chance flood originating from alluvial flooding from northeast of town. The Diversion Channel has a 100 cfs release rate.

Several reservoirs exist in the City of Williams. Santa Fe Reservoir and City Park Reservoir are stable. Upper Saginaw Reservoir may or may not remain due to questions pertaining to the safety of the reservoir dam. All three reservoirs were considered in the original study of the City of Williams. Due to the small size and storage capabilities of the dams, the flood protection provided by these dams is limited.

Floodplain management measures used in the past to reduce potential flood damages consisted of breaching street crossings on upper Cataract Creek to increase the capacity of the wash.

FEMA specifies that all levees must have a minimum of 3 foot freeboard against 1-percent annual chance flooding to be considered a safe flood protection structure.

Levees exist in the study area that provide the community with some degree of protection against flooding. However, it has been ascertained that some levees may not protect the community from rare events such as the 1-percent annual chance flood. The criteria used to evaluate protection against the 1-percent annual chance flood are 1) adequate design, including freeboard, 2) structural stability, and 3) proper operation and maintenance. Levees that do not protect against the

1-percent annual chance flood are not considered in the hydraulic analysis of the 1-percent annual chance floodplain.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this FIS. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the county at the time of completion of this FIS. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding sources studied in detail affecting the county.

Precountywide Analyses

For each community within Coconino County that had a previously printed FIS report, the hydrologic analyses described in those reports have been compiled and are summarized below.

The hydrologic analysis for Cataract Creek, Cataract Creek Tributary, Santa Fe Wash East, and Santa Fe Wash West was performed using the SCS TR-20 computer program (U.S. Department of Agriculture, 1965). Results were compared with data taken from a USGS gage station with 14 years of record on a tributary to Cataract Creek.

Discharges decrease with increasing drainage area on Cataract Creek Tributary due to storage upstream. Discharges on portions of Cataract Creek decrease due to overbank losses upstream.

The hydrologic analyses of the watershed affecting the Oak Creek area including Soldier Wash, Munds Canyon, and Munds Park was performed using the SCS TR-20 computer program (U.S. Department of Agriculture, 1965). Input data for the TR-20 computer program was prepared for the Yavapai County FIS as part of the hydrology report on Oak Creek in Yavapai County (FEMA, 1991).

To obtain peak floodflows at the required concentration points of Oak Creek and tributaries, Soldier Wash, and Munds Canyon, it was necessary to modify the TR-20 model by adding additional concentration points. Further modification, in the form of higher areal reduction factors applied to the precipitation data, was necessary to model the relatively higher peak floodflows occurring from the smaller drainage areas. Therefore, peak discharges for Munds Canyon, Soldier Wash, Munds Park, and upper reaches of Oak Creek are higher than peak discharges obtained at the same location when the lower Oak Creek peak discharges were being investigated.

Discharges on Oak Creek decrease with increasing drainage area between Munds Canyon Creek and the Yavapai County boundary due to overbank storage.

Because of the similar hydrologic characteristics of the Howard Draw Wash drainage area with that of the Oak Creek area, the TR-20 computer program (U.S. Department of Agriculture, 1965) was also used to perform the hydrologic analysis for Howard Draw Wash, using similar input data.

Because starting water-surface elevations for Howard Draw Wash were dependent on lake elevations of Lower Lake Mary, it was necessary to establish the lake elevations for selected recurrence intervals. This was done using a previous hydrology report for the City of Flagstaff (Hydrology Consultants, Inc., 1975).

The USACE had previously studied Rio de Flag and Sinclair Wash in a 1975 report (USACE, 1975). A study addressing floodflow peaks on Rio de Flag and other tributaries within the City of Flagstaff, including Clay Avenue Wash, Fanning Drive Wash, Sinclair Wash, and Switzer Canyon Wash, was published for the City of Flagstaff in 1979 (Arizona Engineering Company, 1979).

A complete review of the hydrology of both reports was conducted. The hydrology model from the City of Flagstaff report (Arizona Engineering Company, 1979) was adopted with minor modifications for use in this FIS.

The hydrology model used to determine peak floodflows for Rio de Flag, Clay Avenue Wash, Fanning Drive Wash, Sinclair Wash, and Switzer Canyon Wash was the USACE's computer program HEC-1 (USACE, 1973).

Analyses were carried out to establish the peak elevation-frequency relationships for floods of the selected recurrence intervals for Mormon and Stoneman Lakes.

No lake gage records exist for Mormon and Stoneman Lakes. Approximate historic lake elevations were determined from recollections of long-time local residents and observations of high water marks from U.S. Forest Service aerial photographs (U.S. Department of Agriculture, 1978). Water-surface elevations were established for both lakes in June 1980 when they were above normal water elevations. Stoneman Lake was said to be at the highest elevation that long-time local residents could remember in June 1980.

The 1-percent annual chance frequency lake elevation for Mormon Lake was established by adding the volume from a 10-day duration, 1-percent annual chance frequency storm to the mean maximum lake elevation as determined from historic information. The 10-day duration rainfall for a 1-percent annual chance storm was computed using SCS methods described in Technical Service Center Technical Note – PO-6 (U.S. Department of Agriculture, 1975). Precipitation values for the analysis were derived from the National Oceanic and Atmospheric Administration Atlas, Volume III (U.S. Department of Commerce, 1973). Using the rainfall computed for the 10-day duration, 1-percent annual chance storms along with runoff curve numbers, the net volume of runoff was calculated using SCS procedures.

An elevation versus storage rating curve was prepared for Mormon Lake. Storage volume was computed by the use of USGS topographic maps (U.S. Department of the Interior, 1965).

Using the mean maximum water-surface elevations determined from historic information with the net volumes of runoff for the 10-day duration storms and the elevation versus storage rating curves, the lake water-surface elevation for the selected recurrence interval was determined. No 2-percent annual chance flood elevation was determined for Mormon Lake.

Elevations of various recurrence intervals were determined for Stoneman Lake using a frequency analysis of a synthetic lake record generated by a water-balance accounting model that was calibrated to information on historic lake levels. Documentation of the model development and assumptions are presented in the report Stoneman Lake Elevation – Frequency Analysis, Coconino County, Arizona (Dames & Moore, 1982).

The hydrologic assumptions used in developing the revision were taken from a report, Methods for Estimating the Magnitude and Frequency of Floods in Arizona (Roeske, R. H., 1978). Regression equations for the high-elevation region in that report were applied to the study area. Discharges for the 1-percent annual chance recurrence interval flood event are listed in Table 5, "Summary of Discharges."

Hydraulic calculations were performed using two USGS models. WSPRO was used for the culvert, road overflow, and floodway computations at Bader and Suzette Roads and the floodway analyses at cross sections D, E, G, and H. The backwater analyses and remaining floodway elevation computations were carried out by the J635 computer model (Federal Highway Administration, undated). Cross sections used for the study were surveyed by USGS personnel in October 1989.

Normal-depth calculations were used to determine the starting water-depth elevation for Baderville Tributary.

Several hydrologic methods were used to establish discharge-frequency relationships for Kanab Creek through the Town of Fredonia. The SCS TR-20 computer program (U.S. Department of Agriculture, 1965) was used, with a Type 1 storm distribution applied with precipitation data obtained from National Oceanic and Atmospheric Atlas Volumes VI and VIII (U.S. Department of Commerce, 1973). The USGS Regression Equation (Arizona Department of Transportation,

1978) and the USGS Index Method (U.S. Department of the Interior, 1962) were also used. These results were compared with the results obtained from a USGS gaging station with 9 years of record (1959 to 1968) on Kanab Creek above the Town of Fredonia as a further check of the results.

The hydrologic analysis of the watershed affecting the Oak Creek area in the City of Sedona, including Soldier Wash, was performed using the NRCS TR-20 computer program (FEMA, 1991). Input data for the TR-20 computer program were prepared for the Yavapai County FIS as part of the hydrology report on Oak Creek in Yavapai County (U.S. Department of the Interior, 1973). To obtain peak floodflows at the required concentration points of Oak Creek and Soldier Wash, it was necessary to modify the TR-20 model by adding additional concentration points. Further modification, in the form of higher area reduction factors applied to the precipitation data, was necessary to model the relatively higher peak flood flows occurring from the smaller drainage areas. Therefore, peak discharges for Soldier Wash and upper reaches of Oak Creek are higher than peak discharges obtained at the same location when the lower Oak Creek peak discharges were being investigated. Discharges on Oak Creek decrease with increasing drainage area between Munds Canyon Creek and the Yavapai County line due to overbank storage.

The hydrologic analysis of the watersheds affecting the City of Williams was performed using the SCS TR-20 computer program (U.S. Department of Agriculture, 1965). Results were compared with data taken from a USGS gaging station with 14 years of record on a tributary to Cataract Creek within the Williams Watershed.

Discharges decrease with increasing drainage area on Cataract Creek and Cataract Creek Tributary due to storage upstream. Discharges on Cemetary Wash and portions of Cataract Creek decrease due to overbank losses upstream.

Revised Analyses

Information on the methods used to determine peak discharge-frequency relationships for the streams restudied as part of this countywide FIS is shown below.

The discharges used for Bow and Arrow Wash, Peak View Wash, Switzer Canyon Wash, and Rio de Flag (West) were obtained from the City of Flagstaff FIS (1996).

For the Rio de Flag restudy, the 10-, 2-, and 1-percent annual chance discharges were obtained using a transfer equation derived from the Methods for Estimating Flood Magnitude and Frequency in Arizona (USGS, 1999). The 0.2-percent annual chance discharge was obtained using graphical interpolation from log-probabilities plots.

A summary of the drainage area-peak discharge relationships for all the streams studied by detailed methods is shown in Table 5, "Summary of Discharges."

TABLE 5 – SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
BADERVILLE TRIBUTARY TO RIO DE FLAG					
At confluence with Rio de Flag	8.10	*	*	385	*
BOW AND ARROW WASH					
Near Bennett Drive	*	*	*	146	*
At Yaqui Drive	*	*	*	155	*
At Intersection of Zumi Drive and Walapai Drive	*	*	*	194	*
Approximately 1,320 feet upstream of Lone Trec Road	*	*	*	243	*
Approximately 3,960 feet downstream of Lone Tree Road	*	*	*	320	*
At confluence with Rio de Flag	2.9	160	320	420	700
CATARACT CREEK					
Downstream of Santa Fe Reservoir Dam	4.95	110[1]	411[1]	938[1]	2,200[1]
Downstream of confluence at Cataract Creek Tributary	6.61	136	486	1,064	2,400
At confluence with West Cataract Creek	7.15	153	519[2]	1,080[2]	2,400
Upstream of Santa Fe Reservoir Dam	4.95	173	601	1,099	2,500
At U.S. Highways 66 & 89	7.15	153	524	1,107	2,400
CATARACT CREEK TRIBUTARY					
Downstream of City Park Dam	1.4	28[1]	91[1]	186[1]	360[1]
Upstream of City Park Dam	1.4	64	257	481	1,100

*Data not available
[1]Decrease due to storage upstream
[2]Decrease due to overbank losses upstream

TABLE 5 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
CEMETARY WASH					
At confluence with West Cataract Creek	1.06	47[1]	185[1]	259[1]	*
At U.S. Highways 66 & 89	1.06	50	209	385	1,050
CLAY AVENUE WASH					
At confluence with Rio de Flag	12.7	80	290	450	1,020
Approximately one mile above confluence with Rio de Flag	12.6	70	280	440	1,000
Near upstream limit of detailed study	9.7	45	210	340	795
CLAY AVENUE WASH SPLIT FLOW					
At confluence with Clay Avenue Wash	[1]	1	36	77	257
COUNTRY CLUB WASH					
At confluence with Rio de Flag	1.6	60	130	170	300
At upstream limit of detailed study, downstream of two reservoirs	1.0	20	40	50	90
FANNING DRIVE WASH					
At confluence with Rio de Flag	2.60	290	570	730	1,200
At Linda Vista Drive	1.03	118	238	307	506
At upstream limit of detailed study	0.93	100	210	270	450
HOWARD DRAW WASH					
At confluence with Lower Lake Mary	9.5	2,370	3,920	4,510	6,400
KANAB CREEK					
At downstream limit of detailed study	287.0	2,830	7,560	10,500	21,500

*Data not available

[1]Floods caused by overflow from Clay Avenue Wash; hence, no applicable drainage area other than the drainage area of Clay Avenue Wash at this location.

TABLE 5 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
MUNDS CANYON CREEK					
At confluence with Oak Creek	64.3	6,180	11,160	14,520	23,000
MUNDS PARK WASH					
At Interstate Highway 17	44.3	5,780	10,140	13,040	20,000
Approximately 600 feet upstream of Interstate Highway 17	21.7	2,870	4,970	6,360	9,300
OAK CREEK					
At Coconino-Yavapai County boundary	245.9	9,450[1]	20,310[1]	26,920[1]	45,650[1]
At confluence of Soldier Wash	236.8	9,930[1]	20,770[1]	27,200[1]	45,700
Approximately 0.6 mile downstream of confluence of Wilson Canyon	225.4	10,350[1]	21,160[1]	27,450[1]	45,000
At confluence of Mund Canyon Creek	215.4	11,230	21,950	27,930	45,000
Upstream of confluence of Munds Canyon Creek	151.0	7,050	13,980	17,140	28,000
Approximately 0.75 mile downstream of Banjo Bill Campground	142.9	6,850	13,660	16,710	27,000
At confluence of West Fork Oak Creek	134.3	6,510	13,080	15,960	26,000
Approximately 1.5 miles downstream of confluence of Pumphouse Wash	87.3	3,570	6,780	8,240	13,000
PEACEFUL VALLEY WASH					
At confluence with Rio de Flag	4.3	110	260	360	670
At upstream limit of study	1.7	40	100	140	260

[1]Decrease due to overbank storage upstream

TABLE 5 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
PEAK VIEW WASH					
At confluence with Rio de Flag (after diversion at Cooper Drive)	0.94	*	*	20	*
Just upstream of the intersection of Cooper Drive and Peak View Tributary Wash	0.94	*	*	105	*
PENSTOCK AVENUE WASH					
At confluence with Rio de Flag	2.3	30	90	140	310
RIO DE FLAG					
Approximately 3.0 miles upstream of confluence with San Francisco Wash (at downstream limit of study)	198.38	1,401	3,239	4,484	8,300
Flow upstream of Townsend Bridge	121.61	1,086	2,487	3,376	6,100
Flow upstream of final Tributary	129.55	1,123	2,573	3,502	6,500
Upstream of U.S. Highway 66	110.6	1,050	2,400	3,250	5,800
At confluence of Switzer Canyon Wash	98.9	1,050	2,400	3,250	5,800
Above confluence of Bow and Arrow Wash	80.3	900	2,000	2,700	4,750
At confluence of Sinclair Wash	67.3	600	1,350	1,850	3,300
Upstream of confluence of Clay Avenue Wash	53.7	510	1,100	1,450	3,000
Above Crescent Drive	50.5	290	840	1,300	2,900
At Narrows Dam	43.3	260	760	1,200	2,600
At confluence of Hidden Hollow Wash	30.6	70	410	680	1,650
Approximately 0.5 mile downstream of road proceeding south from Arizona Snow Bowl Access Road	29.0	70	400	660	1,600

*Data not available

TABLE 5 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
RIO DE FLAG (continued)					
Approximately 0.5 mile upstream of road proceeding south from Arizona Snow Bowl Access Road	23.5	50	320	530	1,300
Approximately 1.33 miles upstream of U.S. Highway 180	12.2	17	142	246	642
RIO DE FLAG SPLIT FLOW					
At confluence with Rio de Flag	[1]	5	278	456	1,260
SANTA FE WASH EAST					
At confluence with Cataract Creek	5.82	304	792	1,305	2,500
Upstream of confluence of Santa Fe Wash West	4.91	156	481	836	1,750
At U.S. Highways 66 and 89	0.92	81	250	421	900
SANTA FE WASH WEST					
At confluence with Santa Fe Wash East	0.91	184	419	708	1,340
At U.S. Highways 66 & 89	0.56	182	393	633	1,340
SCHULTZ CREEK					
At confluence with Rio de Flag	6.0	*	*	440	*
SINCLAIR WASH					
At confluence with Rio de Flag	11.6	350	670	890	1,600
At Palmer Avenue	8.0	100	320	470	990
At upstream limit of detailed study	5.4	50	180	270	600
SOLDIER WASH					
At confluence with Oak Creek	3.3	890	1,420	1,720	2,450

*Data not available

[1]Floods caused by overflow from Rio de Flag; hence, no applicable drainage area other than the drainage area of Rio de Flag at this location.

TABLE 5 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
SPRUCE AVENUE WASH					
At Santa Fe Avenue	7.3	240	460	580	930
Above East Linda Vista Drive	5.7	60	180	260	520
Near upstream limit of detailed study	5.3	50	160	230	480
SWITZER CANYON WASH					
At confluence with Rio de Flag	11.0	280	600	800	1,400
At downstream Turquoise Drive crossing	2.1	80	190	250	450
At upstream corporate limits	*	*	*	150	*
Approximately 528 feet upstream of intersection of Juniper Avenue and Turquoise Drive	*	*	*	150	*
At upstream of Route 66	2.1	*	*	250	*
At Atchison, Topeka, Santa Fe Railway	*	79	108	252	454
At Enterprise Road	*	101	250	346	642
TRIBUTARY 1 TO BADERVILLE TRIBUTARY					
At stream mile 0.76	3.42	*	*	162	*
TRIBUTARY 2 TO BADERVILLE TRIBUTARY					
At stream mile 1.28	1.5	*	*	73	*
WEST STREET WASH					
Below south driveway of High School	0.26	22	45	58	97

*Data not available

The expansion and contraction coefficients used in the HEC-RAS model were determined from the HEC-RAS User's Manual. For gradual transitions, which include more reaches in this study, the contraction and expansion coefficients were set as 0.1 and 0.3, respectively. At locations where the cross-sectional area and flow direction change abruptly, values of 0.2 to 0.4 and 0.4 to 0.6 were used for these coefficients. At structure location values of 0.3 and 0.5 were used.

Hydrology flow values for the Rio de Flag were generated using the integration of FIS flow values and the USGS regression equations for various points along the stream path, and were extrapolated from existing FIS data for the 0.2-percent annual chance flood event where USGS equations were not available.

The stillwater elevations have been determined for the 10-, 2-, 1-, and 0.2-percent annual chance floods for the flooding sources studied by detailed methods and are summarized in Table 6, "Summary of Stillwater Elevations."

TABLE 6 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	ELEVATION (feet NAVD**) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
MORMON LAKE	38.9	7,115.9	*	7,120.4	7,123.4
DETENTION BASIN		*	*	6,925.4	*
STONEMAN LAKE (with diversion ditch closed)	1.44	6,728.6	*	6,732.8	6,735.2

*Data not available
**North American Vertical Datum of 1988

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Precountywide Analyses

Water-surface elevations for floods of the selected recurrence intervals were computed through the use of the USACE HEC-2 step-backwater computer program (USACE, 1976).

Cross sections used for the backwater analysis of Cataract Creek, Cataract Creek Tributary, Munds Park Wash, Santa Fe Wash East, and Santa Fe Wash West were

digitized from aerial photography flown in November 1978 (Aerial Mapping Company, Scale 1:14,400, 1978).

Cross sections used for the backwater analysis of Clay Avenue Wash, Fanning Drive Wash, Rio de Flag (for sections of county within the City of Flagstaff), Sinclair Wash, and Switzer Canyon Wash were digitized from aerial photography flown in September 1975 (Aerial Photographs, City of Flagstaff, 1975).

Cross sections used for the backwater analysis of Howard Draw Wash were digitized from aerial photography flown in October 1978 (Aerial Mapping Company, Scale 1:12,000, 1978).

Cross sections used for the backwater analysis of Munds Canyon Creek, Oak Creek, and Soldier Wash were hand-coded from topographic maps (U.S. Department of Agriculture, 1971).

Cross sections used for the backwater analysis of Rio de Flag (for sections northeast and northwest of the City of Flagstaff) were digitized from aerial photography flown in October 1978 (Aerial Mapping Company, Scale 1:14,400, 1978).

Structural geometry and elevation data for all bridges and dams were obtained from field observations, except for Munds Park Wash at the intersection of Mormon Lake Road, where design plans were used to model the bridge (Coconino County Highway Department, 1980).

No 0.2-percent annual chance flood elevations were modeled or plotted on the profiles for Fanning Drive Wash. The capacity of the wash would not convey the 0.2-percent annual chance flood.

A shallow flooding area east of the City of Williams for Santa Fe Wash West was determined using HEC-2 computations (USACE, 1976) and engineering judgment. For the areas studied by approximate methods, 1-percent annual chance elevations were determined from normal depth calculations using Manning's equation.

No profile is shown for Cataract Creek Tributary for approximately 370 feet downstream of City Port Dam due to the extreme steepness of the spillway (an approximate 18-foot vertical drop per 100 feet).

Cross sections used for the backwater analysis of the detailed study areas in the City of Flagstaff were digitized from aerial photography flown in September 1975, at a negative scale of 1:6,000 (Aerial Photographs, City of Flagstaff, 1975). Cross sections for the upstream portion of Sinclair Wash were digitized from aerial photography flown in October 1978, at a negative scale of 1:14,000 (Aerial Photographs, Sinclair Wash, 1978). The City of Flagstaff report (Arizona Engineering Company, 1979), along with field observations, was used to obtain structural geometry and elevation data for all bridges, dams, and culverts. Cross-section information for the channelized portion of Rio de Flag and Peak View Wash in northwest Flagstaff was obtained from design plans (Willdan Associates, 1977; Willdan Associates, 1980).

Starting water-surface elevations for Rio de Flag, Peaceful Valley Wash, and Country Club Wash were based on storage-routing using the USACE HEC-1 computer program (USACE, 1973). The storage-routing condition occurring at U.S. Highway 66 causes ponding upstream of U.S. Highway 66 past the confluences of Peaceful Valley Wash and Country Club Wash with Rio de Flag for the 10-, 2-, 1-, and 0.2-percent annual chance floods.

Water-surface elevations in the City of Flagstaff were computed with obstruction of modeled hydraulic structures considered. This approach was considered necessary because of the high debris potential due to urbanization and natural vegetation.

The best available mapping was used for approximate study analysis. Approximate study areas, described as Unnamed Wash (intersection of Interstate Highways 40 and 17), east fork of Upper Switzer Canyon Wash, lower Spruce Avenue Wash, and lower Rio de Flag (approximately 1.7 miles), were studied to determine delineations for the 1-percent annual chance flood by use of normal-depth calculations using Manning's equation. The remaining approximate study areas, described as upper Switzer Canyon Wash and Rio de Flag (approximately 0.7 mile below U.S. Highway 66), were delineated for the 1-percent annual chance flood based on the City of Flagstaff drainage report (Arizona Engineering Company, 1979).

Shallow flooding analysis for determining depths and/or levels of flooding in general involved one or more of the following analyses: HEC-2 computer program for determining flooding depths and/or levels; normal-depth hydraulic computations for determining depth of floodwaters; and weir flow and/or rating curve analysis for determining the amount of breakout flow from the main channel.

Rio de Flag Split Flow is separated from the main channel by an area of shallow flooding between Navajo Drive and Thorpe Road. The water-surface elevations are slightly higher in the main channel than in the adjacent area of ponding due to the slight amount of head needed to initiate weir flow.

An area of shallow flooding of less than 1.0 foot occurs along Fremont Boulevard near its intersection with Rio de Flag.

Shallow flooding occurs east of Penstock Avenue Wash from between Empire and Commerce Avenues to between Railhead Avenue and U.S. Highway 66.

One area of shallow flooding along Fanning Drive Wash breaks out along Linda Vista Drive and flows south to U.S. Highway 66. Another area of shallow flooding occurs between Fanning Drive Wash, Linda Vista Drive, and Fanning Drive.

An area of ponding occurs along Switzer Canyon Wash between Huntington Drive and Interstate Highway 40.

Shallow flooding occurs along Spruce Avenue Wash from Linda Vista Drive south along Grandview Drive and First and Second Streets to the Atchison, Topeka & Santa Fe Railroad. Shallow flooding occurs between Spruce Avenue Wash and West Street Wash below First Avenue. An area of shallow flooding east of Spruce Avenue Wash occurs between Cedar Avenue south along Rose and Third Streets to just north of Sixth Avenue.

Another area of shallow flooding occurs along the northern end of Paradise Road and between Paradise Road and Spruce Avenue Wash north of Park Way.

A drainage pipe at Sixth Avenue intercepts a large portion of the West Street Wash 1-percent annual chance discharge. The remaining discharge causes shallow flooding with an average depth of less than 1 foot south of Sixth Avenue, between Izabel Street and East Street.

An area of divided flow occurs on Rio de Flag along Bonito Street from Thorpe Road to Elm Avenue. West Street Wash has divided flow between Second and Johnson Avenues. Clay Avenue Wash has divided flow between cross sections P and T. At the Rio de Flag and Clay Avenue Wash areas of split flow, the 10-percent annual chance flood is contained in the main channel.

No 0.2-percent annual chance flood elevations were modeled or plotted on the profiles for Penstock Avenue and Fanning Drive Washes. It is estimated that the 0.2-percent annual chance flood event for Penstock Avenue Wash will break out below station 0.894 and return at station 0.11 resulting in shallow flooding of not more than 1.0 foot on the average. It is estimated that the 0.2-percent annual chance flood event for Fanning Drive Wash will break out between stations 1.88 and 1.50 along Linda Vista Drive. Most of this flooding will not return to the channel.

Cross sections used for the backwater analysis of the detail-study areas in the Town of Fredonia were digitized from aerial photographs flown in November 1978 at a negative scale of 1:14,400 (Aerial Mapping Company, Scale 1:14,400, 1978). Structural geometry and elevation data for all bridges and dams were obtained from field observations.

Approximate flooding for Lost Spring Wash was determined from a Flood Hazard Boundary Map (U.S. Department of Housing and Urban Development, 1978), and tied into detailed flooding from Kanab Creek.

Cross sections used for the backwater analysis of Oak Creek and Soldier Wash were hand-coded from topographic maps (U.S. Department of Agriculture, 1971).

Starting water-surface elevations for Cataract Creek and Cataract Creek Tributary were derived from normal-depth calculations. Starting water-surface elevations for Santa Fe Wash East were determined using critical depth. Starting water-surface elevations for Santa Fe Wash West were taken from Santa Fe Wash East.

Starting water-surface elevations for Cemetary Wash were derived from a rating curve for the culverts at Interstate Highway 40.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the FIRM (Exhibit 2).

This revised hydraulic analysis was based on more detailed topographic information for the right overbank of Oak Creek at cross section S. The result of this analysis was an increase in the BFEs and a decrease in the width of the Special Flood Hazard Area and floodway along Oak Creek between cross sections R and T. In addition, the width of the floodway was increased by 27 feet at cross section V.

The revision along Switzer Canyon Wash was based on new detailed flooding for Switzer Canyon Wash produced by the USACE, Los Angeles District, as part of the Limited Map Maintenance Program study for the City of Flagstaff, Arizona. The hydraulic analysis was performed using the USACE Computer Program 723-X6-L Water-Surface Profiles.

Hydraulic calculations were performed using two USGS models. WSPRO was used for the culvert, road overflow, and floodway computations at Bader and Suzette Roads and the floodway analyses at cross sections D, E, G, and H. The backwater analyses and remaining floodway elevation computations were carried out by the J635 computer model (Federal Highway Administration, Version P-84.001, undated). Cross sections used for the study were surveyed by USGS personnel in October 1989.

Normal-depth calculations were used to determine the starting water-depth elevation for Baderville Tributary.

The revised hydraulic analysis was performed using the USACE HEC-2 step-backwater computer program. Because of the new topography, the BFEs were increased, the 1- and 0.2-percent annual chance floodplain boundaries were modified, and the 1-percent annual chance floodway was realigned.

The HEC-2 hydraulic computer model was used to determine the base (1-percent annual chance) flood elevations. The starting water-surface elevation was taken from the previous study. The cross-section data for the channelized portions of the wash was obtained from the USGS and the City of Flagstaff Engineering Division. Overbank information was obtained from aerial topographic maps. Roughness coefficients were chosen by engineering judgment and based on field observations.

A hydraulic analysis was performed to determine the channel capacity for Switzer Canyon Wash. Cross sections for the hydraulic analysis were taken from topographic maps at a scale of 1:1,200, with a contour interval of 2 feet (Aerial Mapping Company, 1975). Cross sections in all detailed study areas were located at close intervals upstream and downstream of pipe culverts to investigate possible significant backwater effects. All road crossings were surveyed to obtain pipe sizes

and elevation data. The portion of Switzer Canyon Wash from the upstream Turquoise Drive crossing to the Meadow Lark Drive crossing is an underground pipe which is assumed to be 50-percent open during a 1-percent annual chance flood event. The discharge through the pipe was calculated to be 100 cfs by using Chart 6 of the Hydraulic Charts for the Selection of Highway Culverts (U.S. Department of Transportation, 1965).

Roughness coefficients (Manning's "n") used in the HEC-2 computer program computations were determined by the Cowen Method (Chow, Ven Te, 1959). A field trip to the City of Flagstaff, Arizona, was made to obtain the necessary information for the selection of roughness coefficient values, which were determined to be between 0.035 and 0.060 for this portion of the study.

The hydraulic analyses for the revised study were performed using the USACE HEC-2 step-backwater hydraulic computer model. The revised hydraulic analyses were performed to develop 1-percent annual chance floodway boundaries and modify the existing 1-percent annual chance floodplain boundaries. The revised hydraulic analyses incorporate updated topographic information along Clay Avenue Wash from 0.300 mile upstream to 0.925 mile upstream of its confluence with Rio de Flag.

The cross-section data for the channelized portion of Fanning Drive and Penstock Avenue Washes was obtained from the USGS and the City of Flagstaff Engineering Division. Overbank information was obtained from aerial topographic maps for all cross sections were digitized from topographic maps obtained from the USGS. All elevations are referenced to the NAVD.

Revised Analyses

The revised hydraulic analyses resulted in changes to the BFEs, modifications to the floodplain boundaries, and the addition of a floodway along Clay Avenue Wash from approximately 0.300 mile upstream to 0.925 mile upstream of the confluence with Rio de Flag. In support of this revision, the following technical data were submitted:

- A topographic map of Clay Avenue Wash from 0.300 mile upstream to 0.925 mile upstream of the confluence with Rio de Flag, prepared by the City of Flagstaff, dated May 1988; and

- As-built drawings of Westglen Mobile Home Park, Public and Private Improvements, prepared by P & D Technologies, dated January 25, 1989.

The floodplains were analyzed using BOSS RMS Version 2000 software. RMS is an enhanced version of the USACE HEC-RAS program (USACE, Version 3.1.1, May 2003). This enhanced version was developed by the University of Brigham Young Computer Research Laboratory and is distributed by Boss International, Inc.

The work study maps consisted of the 2-foot contour intervals topographic mapping. Also, USGS 7.5-minute quadrangle topographic mapping with a 1:24,000 scale, and

20-foot contour intervals. However, due to the lack of accuracy or inconsistencies between mapping sources, these maps were used as reference purposes only and topographic information was obtained by field survey.

A combined terrain was compiled using a combination of available 3' DEM data, digitized contour data associated with the effective study and 30' USGS DEMs for the Rio de Flag. Hydraulics were then calculated in HEC-RAS Version 3.1.3 and used as the basis for determining floodplain and floodway extents.

This riverine study project involves the delineation of five washes:

- Rio de Flag
- Schultz Creek
- Switzer Canyon Wash
- Peak View Wash
- Bow and Arrow Wash

Each wash was divided into several reaches of similar hydraulic characteristics, and Manning's "n" values were assigned to these reaches based on their typical channel characteristics. Each reach was identified with an alphanumeric identifier, representing the name of the wash followed by the reach number. For example, SCW-1 represents Reach 1 of Switzer Canyon Wash, while S-3 represents Reach 3 of Schultz Creek Wash. The reach number starts with "1" at the upstream end and increases in the downstream direction. The identifier used for each of the washes is summarized below.

Riverine Name	Reaches
Rio de Flag (West)	RFW-1 to RFW-3
Peak View Wash	PVT-1 to PVT-2
Schultz Creek	S-1 to S-5
Switzer Canyon Wash	SCW-1 to SCW-9
Bow and Arrow Wash	B7A-1 to B&A-7
Rio de Flag (East)	RFE-1 to RFE-5

Manning's roughness coefficients were determined in accordance with the methodology described in Estimated Manning's Roughness Coefficient for Streams, Channels, and Floodplains in Maricopa County, Arizona. The method described in this publication selects a base value for the roughness coefficient based exclusively on bed material. This base value is then adjusted to account for vegetation, irregularities, obstructions, and channel cross-section variations. In addition, a multiplier was applied to the adjusted "n" value when meandering of the reach was significant.

The base roughness coefficient in this study was selected based on the average particle size observed in the field. The typical bed materials in the study area range from coarse sand to medium boulder and the typical values of the roughness coefficient range from 0.035 to 0.12. For the washes running adjacent to the paved roads (e.g., Bow and Arrow Wash), the Manning's "n" values for the overbank

include a composed value of the roadway, roadway embankment, and adjacent ground. Obstructions created by structures were ignored in the calculation of "n" values because the cross section excluded the structures from the flow area.

The cross sections used for the hydraulic modeling were provided by the City of Flagstaff based on survey data.

There are several locations where hydraulic jumps appear to occur. The majority of these locations are near a structure.

Rio de Flag: In this model, there are four apparent locations that produce hydraulic jumps due to culverts and a steep slope, approximately, ½ mile downstream of the culvert located at El Paso Road, due to a steep slope in the wash. This slope creates high velocities and supercritical flow conditions. The second location is just downstream of the culvert at El Paso Road and the third location is just downstream of the culvert at El Compressor Road, both due to the obstruction of flow from the culvert. The fourth apparent hydraulic jump is approximately 300 feet downstream of the culvert at Fremont Boulevard due to steep slopes and the impoundment created by Narrows Dam downstream.

Schultz Creek: In this model, there are several apparent locations that produce hydraulic jumps due to culverts and a confluence with Rio de Flag. At approximately 120 feet north of the confluence with Rio de Flag, there appears to be a hydraulic jump. This is due to the drop into the Rio de Flag at the confluence. Between Mary Russell Way and just downstream of Colter House Road, there are several locations in between these two roadways that have apparent hydraulic jumps, due to the obstructions of the culverts at the roadway crossings.

Switzer Canyon Wash: In this model, there are several apparent locations that produce hydraulic jumps due to culverts and changes in slopes. Just south of Turquoise Drive, the culvert produces high velocities through the structure and a hydraulic jump downstream. Approximately 780 feet southeast of Forest Avenue along the wash, the culvert produces high velocities through the structure and a hydraulic jump downstream. Other locations of hydraulic jumps; southeast of the intersection of Turquoise Drive and Oak Avenue due to the culvert at this location; south of McPhearson Park Driveway due to the culvert at this location; and lastly, approximately 480 feet north of McPhearson Park Driveway and continues to about 670 feet upstream of the channel. The grade slightly increases in this location, thus creating hydraulic jumps in this area.

Peak View Wash: In this model, there appears to be two locations where hydraulic jumps occur. The two locations, south of Mountain Drive and the other south of Lois Lane, both hydraulic jumps are due to the culverts at the crossing locations and the slope transition between steep to gradual at the structure, thus creating high velocities and hydraulic jumps downstream of the structure location.

Bow & Arrow Wash: In this model, there appears to be two locations that produce hydraulic jumps due to a culvert and a change in slope. The first location is ½ mile downstream of Lake Mary Road along the wash. The channel in this location

changes from a steep to a gradual slope, thus creating a hydraulic jump. The second location is just downstream of Lake Mary Road at the culvert outlet.

There are many locations within the washes showing divided flow conditions. These divided flows appear to be isolated islands and the flows appear to be hydraulically connected both upstream and downstream.

Rio de Flag: Just south of the county boundary continuing about ½ mile downstream along the wash, the flow is not contained in the channel and spreads over a large area. The cross sections show several small islands, but they are just local high points and the flow appears to be hydraulically connected.

Schultz Creek: Approximately 400 feet north of the confluence with Rio de Flag Wash, there is some flow that may leave the main wash. This flow is assumed to be small and the split was ignored in the model. Schultz Creek has a well-defined channel upstream of Highway 180. Downstream from the highway, the flow spreads through a wide area of shallow flow.

There are several locations showing divided flow, these divided flows appear to be isolated islands and are hydraulically connected both upstream and downstream.

Switzer Canyon Wash: There are several locations showing divided flow, these divided flows appear to be isolated islands and appear to be hydraulically connected both upstream and downstream.

Peak View Wash: There is no divided flow in this model. However, there is a flow split at Cooper Drive near the confluence with the Rio de Flag Wash.

Bow & Arrow Wash: There are several locations showing divided flows. These divided flows appear to be isolated islands and appear to be hydraulically connected both upstream and downstream.

Just southwest of Mohawk Drive, for approximately 130 feet, there appears to be divided flow conditions showing a secondary channel to the left of the main channel. Based on review of the geometry, it doesn't appear that flow conditions are affected by this condition.

After the preliminary flooding boundaries were plotted, the wash cross sections were checked to insure that each reflected the actual flow area. Several cross sections were modified to exclude tributaries and non-effective areas. The ineffective flow area stations were estimated based on topographic mapping. The criteria of 1:1 contraction and 4:1 expansion rates were used for determining the ineffective flow areas.

There are many locations within the washes showing supercritical flow. Most of these locations are associated with roadway crossings.

Rio de Flag: There are several locations that appear to produce supercritical flow conditions. Most of these locations are associated with roadway crossings and include the following:

- Downstream from the culvert outlet at Fremont Boulevard, it appears that the flow is confined to the roadway culvert. This and the steep grades upstream from the culvert result in an acceleration of the flow and supercritical flow conditions.
- Upstream from the culvert inlet at Fremont Boulevard, it appears that the flow is confined to the roadway culvert. This and the steep grades upstream result in an acceleration of the flow and supercritical flow conditions.
- Approximately 430 feet northwest of the roadway intersection of Fremont Boulevard and Boldt Drive, it appears that the flow is confined to the roadway culvert, thus creating supercritical flow conditions.
- Approximately 330 feet southeast of the county boundary, it appears that the inundation limits are contracting between cross sections, thus creating a supercritical flow conditions.
- Approximately 300 feet north of the county boundary, the slope gradually increases. This slope creates high velocities and supercritical flow conditions that continue in several different areas to approximately 1,850 feet south of the county boundary.

Schultz Creek: There are several locations that appear to produce supercritical flow conditions.

- Approximately 2,000 feet above the confluence with Rio de Flag, the wash flows through a developed area, where the flow is forced through streets and alleys resulting in supercritical flows.
- Upstream from Highway 180, approximately 1/3 of a mile the slope gradually increases. This slope creates high velocities and supercritical flow conditions that continue to Highway 180.
- Upstream from Mary Russell Way, it appears that the flow is confined to the roadway culvert. This and the steep grades upstream result in an acceleration of the flow and supercritical flow conditions that continues to approximately 1,300 feet north of the roadway crossing.
- Approximately 340 feet south of the city boundary, it appears that the inundation limits are contracting between cross sections, thus creating a supercritical flow conditions that continue to the corporate boundary limits.

Switzer Canyon Wash: There are five locations where supercritical flow conditions occur.

Peak View Wash: There are two locations where supercritical flow conditions occur.

Bow & Arrow Wash: All along the wash between Leupp Drive to Yaqui Drive, there are several locations of supercritical flow conditions. These are mainly due to the wash crossings at developed areas. This development constricts flow between properties, thus creating either an expansion or contraction between cross sections.

The channel slope that changes because the numerous man made structures such as driveways and fences. This change in slope and cross section creates high velocities and supercritical flow conditions along this reach.

For the Rio de Flag, water-surface elevations of floods of the selected recurrence intervals were computed through use of the USACE HEC-RAS step-backwater computer program (USACE, 2003). Hydraulic model variables were obtained primarily from two sources: the existing FIS for the eastern portion of the study reach, and the Entellas restudy conducted in 2004 for the western portion of the study reach. This current study combined both model sections into one continuous model and incorporated the revised flow values.

The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the streams and floodplain areas. Roughness factors for all streams studied by detailed methods are shown in Table 7, "Manning's "n" Values and Determination Methods for Starting Water-Surface Elevations."

TABLE 7 – MANNING'S "N" VALUES AND DETERMINATION METHODS FOR STARTING WATER-SURFACE ELEVATIONS

		Range of Manning's "n" Values		
Study Area	Method for Determining Starting Water-Surface Elevation	Left Overbank	Channel	Right Overbank
Bow and Arrow Wash	Based on backwater from Rio de Flag (HEC-2)	0.017-0.150	0.017-0.072	0.017-0.200
Cataract Creek	Normal depth calculations	0.014-0.077	0.014-0.055	0.014-0.077
Cataract Creek Tributary	Normal depth calculations	0.014-0.077	0.014-0.055	0.014-0.077
Clay Avenue Wash	Slope/area method	0.030-0.100	0.024-0.040	0.045-0.050
Country Club Wash	Storage-Routing at U.S. Highway 66 from HEC-1	0.031-0.034	0.017-0.034	0.031-0.034
Fanning Drive Wash	Culvert and weir computations over Interstate Highway 40 (eastbound lane)	0.020-0.053	0.017-0.043	0.020-0.053
Howard Draw Wash	Lower Lake Mary water-surface elevations	0.040-0.055	0.030-0.045	0.040-0.050
Munds Canyon Creek	Slope/area method	0.080-0.088	0.065-0.073	0.080-0.088

TABLE 7 – MANNING'S "N" VALUES AND DETERMINATION METHODS FOR STARTING WATER-SURFACE ELEVATIONS - continued

Study Area	Method for Determining Starting Water-Surface Elevation	Range of Manning's "n" Values		
		Left Overbank	Channel	Right Overbank
Munds Park Wash	Slope/area method	0.035-0.045	0.013-0.039	0.030-0.049
Oak Creek	Based on water-surface elevations obtained from Yavapai County FIS	0.079-0.180	0.030-0.080	0.079-0.135
Peaceful Valley Wash	Storage-Routing at U.S. Highway 66 from HEC-1	0.036	0.034	0.036
Peak View Wash	Culvert computations at Service Road crossing	0.045-0.058	0.040-0.053	0.045-0.058
Penstock Avenue Wash	Critical Depth	0.028-0.150	0.015-0.038	0.028-0.150
Rio de Flag	Slope/area method and storage-routing at U.S. Highway 66 from HEC-2	0.015-0.150	0.015-0.061	0.015-0.150
Santa Fe Wash East	Critical Depth	0.036-0.107	0.015-0.072	0.039-0.107
Schultz Creek		0.045-0.120	0.015-0.085	0.047-0.120
Sinclair Wash	Critical depth over O'Leary Street	0.045-0.050	0.024-0.040	0.045-0.050
Soldier Wash	Slope/area method	0.070-0.090	0.018-0.050	0.055-0.090
Spruce Avenue Wash	Critical Depth over Sixth Avenue	0.020-0.150	0.020-0.040	0.020-0.150
Switzer Canyon Wash	Slope/area method	0.035-0.150	0.030-0.085	0.018-0.113
Unnamed Wash West Street Wash	Critical Depth over Santa Fe Avenue	0.050-0.150	0.035-0.045	0.050-0.150

Behind-Levee Analyses

Some flood hazard information presented in prior FIRMs and in prior FIS reports for Coconino County and its incorporated communities was based on flood protection provided by levees. Based on the information available and the mapping standards of the National Flood Insurance Program (NFIP) at the time that the prior FISs and FIRMs were prepared, FEMA accredited the levees as providing protection from the flood that has a 1-percent annual chance of being equaled or exceeded in any given year. For FEMA to continue to accredit the identified levees with providing protection from the base flood, the levees must meet the criteria of the Code of Federal Regulations, Title 44, Chapter I, Section 65.10 (44 CFR 65.10), titled "Mapping of Areas Protected by Levee Systems."

On August 22, 2005, FEMA issued "Procedure Memorandum No. 34 – Interim Guidance for Studies Including Levees." The purpose of the memorandum was to help clarify the responsibility of community officials or other parties seeking recognition of a levee by providing information identified during a study/mapping project. Often, documentation regarding levee design, accreditation, and the impacts on flood hazard mapping is outdated or missing altogether. To remedy this, Procedure Memorandum No. 34 provides interim guidance on procedures to minimize delays in near-term studies/mapping projects, to help our mapping partners properly assess how to handle levee mapping issues.

While documentation related to 44 CFR 65.10 is being compiled, the release of a more up-to-date FIRM for other parts of a community or county may be delayed. To minimize the impact of the levee recognition and certification process, FEMA issued "Procedure Memorandum No. 43 – Guidelines for Identifying Provisionally Accredited Levees" on March 16, 2007. These guidelines allow issuance of the FIS and FIRM while levee owners or communities compile full documentation required to show compliance with 44 CFR 65.10. The guidelines also explain that a FIRM can be issued while providing the communities and levee owners with a specified timeframe to correct any maintenance deficiencies associated with a levee and to show compliance with 44 CFR 65.10.

FEMA contacted the communities within Coconino County to obtain data required under 44 CFR 65.10 to continue to show the levees as providing protection from the flood that has a 1-percent annual chance of being equaled or exceeded in any given year.

FEMA understood that it may take time to acquire and/or assemble the documentation necessary to fully comply with 44 CFR 65.10. Therefore, FEMA put forth a process to provide the communities with additional time to submit all the necessary documentation. For a community to avail itself of the additional time, it had to sign an agreement with FEMA. Levees for which such agreements were signed are shown on the final effective FIRM as providing protection from the flood that has a 1-percent annual chance of being equaled or exceeded in any given year and labeled as a Provisionally Accredited Levee (PAL). Communities have two years from the date of FEMA's initial coordination to submit to FEMA final accreditation data for all PALs. Following receipt of final accreditation data, FEMA will revise the FIS and FIRM as warranted.

FEMA coordinated with the local communities and other organizations to compile a list of levees based on information from the FIRM and community provided information.

Approximate analyses of "behind levee" flooding were conducted for all the levees to indicate the extent of the "behind levee" floodplains. The methodology used in these analyses is discussed below.

Embankment with inventory ID # 3 is located on an unnamed stream. Based on the FIS and topographic information provided by the City of Flagstaff, a shallow

flooding analysis was used to delineate the approximate area of 1-percent annual chance flooding in the event of failure of the structure.

Embankment with inventory ID # 7 is located on Tucker Flat Wash. Based on topographic information from the USGS (i.e., 10m DEMs) the approximate area of 1-percent annual chance flooding in the event of failure of the structure was delineated to connect the discontinuous floodplain from upstream of Burlington Northern Sante Fe Railroad to the floodplain downstream of the railroad.

Embankment with inventory ID # 10 is located on Schoolhouse Draw and Pump House Wash. Based on topographic information from the USGS (i.e., 10m DEMs) the approximate area of 1-percent annual chance flooding in the event of failure of the structure was delineated to connect the discontinuous floodplain from upstream of Interstate 17 to the floodplain downstream of the interstate.

Embankment with inventory ID # 11 is located on an unnamed stream. Based on topographic information from the USGS (i.e., 10m DEMs) the approximate area of 1-percent annual chance flooding in the event of failure of the structure was delineated to connect the discontinuous floodplain from upstream of U.S. Route 66 to the floodplain downstream of U.S. Route 66.

Embankment with inventory ID # 12 is located on Wildcat Canyon Creek. Based on topographic information from the USGS (i.e., 10m DEMs) the approximate area of 1-percent annual chance flooding in the event of failure of the structure was delineated to connect the discontinuous floodplain from upstream of County Highway 394 to the floodplain downstream of the highway.

Embankment with structure ID # 14 is located on the Rio de Flag at Interstate 40. A hydrologic analysis, which included extrapolation of the discharges in the FIS dated August 2, 1996, was used to determine the discharges in the Rio de Flag for the without I-40 embankment scenario. A hydraulic HEC-RAS model was developed for this reach using cross section and bridge data from the existing hydraulic models for the Rio de Flag. These hydraulics models were obtained from FEMA and the 2004 TSDN prepared by Entellus. The resulting floodplain showing the approximate area of 1-percent annual chance flooding in the event of failure of the I-40 embankment was delineated using topographic data from the City of Flagstaff, the 10 m DEMs from the USGS and an undated FEMA workmap for the Rio de Flag.

Embankment with inventory ID # 20 is located on Cataract Creek. Based on topographic information from the USGS (i.e., 10m DEMs) the approximate area of 1-percent annual chance flooding in the event of failure of the structure was delineated to connect the discontinuous floodplain from upstream of Interstate 40 to the floodplain downstream of the interstate.

Qualifying bench marks within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability

classification of A, B, or C are shown and labeled on the FIRM with their 6-character NSRS Permanent Identifier.

Bench marks cataloged by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)
- Stability B: Monuments which generally hold their position/elevation well (e.g., concrete bridge abutment)
- Stability C: Monuments which may be affected by surface ground movements (e.g., concrete monument below frost line)
- Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line, or steel witness post)

In addition to NSRS bench marks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain current elevation, description, and/or location information for bench marks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their Web site at www.ngs.noaa.gov.

It is important to note that temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with this FIS and FIRM. Interested individuals may contact FEMA to access this data.

3.3 Vertical Datum

All FISs and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FISs and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD 29). With the finalization of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are being prepared using NAVD 88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD 88. Structure and ground elevations in the community must, therefore, be referenced to NAVD 88. It is important to note that adjacent communities may be

referenced to NGVD 29. This may result in differences in base flood elevations across the corporate limits between the communities. The conversion factors for all detailed studied streams, with the exception of Peak View Wash and Schultz Creek, are shown in the following Table 8, "Vertical Datum Conversion Factors:"

TABLE 8 – VERTICAL DATUM CONVERSION FACTORS

Baderville Tributary to Rio de Flag	3.496
Bow and Arrow Wash	3.382
Cataract Creek	3.252
Cataract Creek Tributary	3.287
Cemetary Wash	3.234
Clay Avenue Wash	3.412
Clay Avenue Wash Split Flow	3.412
Country Club Wash	3.390
Detention Basin	3.390
Fanning Drive Wash	3.458
Howard Draw Wash	3.401
Kanab Creek	2.952
Morman Lake	3.400
Munds Canyon Creek	2.842
Munds Park Wash	3.155
Oak Creek	2.837
Peaceful Valley Wash	3.398
Penstock Avenue Wash	3.435
Rio de Flag	3.461
Rio de Flag Split Flow	3.461
Santa Fe Wash East	3.238
Santa Fe Wash West	3.231
Sinclair Wash	3.388
Soldier Wash	2.648
Spruce Avenue Wash	3.380/3.460
Stoneman Lake	3.200
Switzer Canyon Wash	3.402
Tributary Number 1 to Baderville Tributary	3.506
Tributary Number 2 to Baderville Tributary	3.490
Unnamed Wash	3.390
West Street Wash	3.435

For more information on NAVD 88, see Converting the National Flood Insurance Program to the North American Vertical Datum of 1988, FEMA Publication FIA-20/June 1992, or contact the Spatial Reference System Division, National Geodetic Survey, NOAA, Silver Spring Metro Center, 1315 East-West Highway, Silver Spring, Maryland 20910 (Internet address http://www.ngs.noaa.gov).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS provides 1-percent annual chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent annual chance flood elevations; delineations of the 1- and 0.2-percent annual chance floodplains; and 1-percent annual chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the county. For the streams studied in detail, the 1- and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4,800, with a contour interval of 4 feet (PRC Toups, 1978), for the study areas of Cataract Creek, Cataract Creek Tributary, Santa Fe Wash East, Santa Fe Wash West, Munds Park Wash, Howard Draw Wash, and Rio de Flag (for areas northeast and northwest of Flagstaff).

Boundaries were interpolated between cross sections using topographic maps at a scale of 1:2,400, with a contour interval of 5 feet (U.S. Department of Agriculture, 1971), for the study areas of Oak Creek, Soldier Wash, and Munds Canyon Creek. Boundaries were interpolated between cross sections using topographic maps at a scale of 1:4,800, with a contour interval of 2 feet (City of Flagstaff, 1975), for the study areas of Clay Avenue Wash, Fanning Drive Wash, Rio de Flag (for sections of county within the City of Flagstaff), Sinclair Wash, and Switzer Canyon Wash.

Flood boundaries for Stoneman Lake were delineated using topographic maps at a scale of 1:1,200, with a contour interval of 1 foot (U.S. Department of Agriculture, 1980).

Flood boundaries for Mormon Lake were delineated using topographic maps at a scale of 1:4,800, with a contour interval of 4 feet (PRC Toups, 1978).

Approximate flood boundaries for portions of Oak Creek and Rio de Flag were delineated using topographic maps at a scale of 1:2,400, with a contour interval of 5 feet (U.S. Department of Agriculture, 1971), and at a scale of 1:4,800, with a contour interval of 2 feet (City of Flagstaff, 1975).

Approximate 1-percent annual chance boundaries on lower Rio de Flag were determined using estimated elevations and delineated on topographic maps at a scale of 1:24,000, with a contour interval of 20 feet (USACE, 1976). Approximate

1-percent annual chance boundaries on Unnamed Wash, Switzer Canyon Wash, Spruce Avenue Wash, and Rio de Flag were determined using estimated elevations and delineated on topographic maps at a scale of 1:4,800, with a contour interval of 2 feet (U.S. Department of Commerce, 1973).

Flood boundaries for areas of shallow flooding were delineated using topographic maps at a scale of 1:4,800 with contour intervals of 2 and 4 feet, in conjunction with determined elevations and/or depths (U.S. Department of Commerce, 1973; Dames & Moore, 1982).

BFEs and a 1-percent annual chance floodway were produced for this reach of Switzer Canyon Wash, along with revised 1-percent annual chance floodplain boundaries. Topographic maps produced by the Aerial Mapping Company, Inc., of Phoenix, Arizona, at a scale of 1:1,200, with a contour interval of 2 feet, were used by the USACE to delineate the new floodplain and floodway boundaries.

Topographic maps produced by WET at a scale of 1:600, with a contour interval of 5 feet, were utilized to delineate the new floodplain and floodway boundaries. Field surveys for the new topography were taken between June and October of 1988, and the final topographic work map used is entitled "Living Springs, Floodplain Limits," Panel H-1, prepared by WET, dated July 6, 1989.

Flood boundaries for the updated flood hazards for Peak View Wash and Schultz Creek along with reaches of the Rio de Flag, Switzer Canyon Wash, and Bow and Arrow Wash were delineated using topographic maps with a contour interval of 2 feet and USGS 7.5-minute quadrangles topographic mapping at a 1:24,000 scale with 20-foot contour intervals.

Flood boundaries for the Rio de Flag restudy were delineated using topographic information compiled from three sources: a digital elevation model (DEM) provided by the City of Flagstaff which included recent LiDAR data, USGS 10m DEMs, and topographic maps at a scale of 1:4,800 with contour intervals of 4 feet (PRC Toups, 1978).

The 1- and 0.2-percent annual chance floodplain boundaries are shown on the FIRM. On this map, the 1-percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, and AO), and the 0.2-percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent annual chance floodplain boundaries are close together, only the 1-percent annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1-percent annual chance floodplain boundary is shown on the FIRM (Exhibit 2).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent annual chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent annual chance flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this FIS are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this FIS were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain.

Due to the confined nature and high velocities on Oak Creek between cross sections AP and BU, and between cross sections BV and CE, the 1-percent annual chance floodplain was designated as the floodway.

The floodways presented in this study were computed on the basis of equal-conveyance reduction from each side of the floodplain. There are two exceptions to this statement. The first occurs from cross sections CJ to DE on Rio de Flag, through a heavily urbanized area of the City of Flagstaff, where the equal-conveyance reduction method failed to produce an appropriate floodway. With the approval of the City of Flagstaff and FEMA, a floodway was established through this area of Rio de Flag using fixed encroachments.

The second exception occurs from U.S. Highway 66 to approximately cross section AN on the lower reach of detailed study of Rio de Flag. This reach of Rio de Flag is subjected to ponding of floodwaters behind U.S. Highway 66 due to a relatively small-capacity culvert under the high U.S. Highway 66 road embankment. The floodplain elevations and delineations on this reach of Rio de Flag were determined using the storage-routing option of the HEC-1 hydrology computer program. This storage-routing analysis involved determining the peak flood elevation occurring for the volume of floodwater entering the area behind U.S. Highway 66, the volume of floodwater exiting at the highway, and the storage capacity behind the highway. It, therefore, was also necessary to determine the floodway for this ponded area of Rio de Flag by volume analysis. The established floodway limits could not allow the base flood water-surface elevation to rise by more than 1.0 foot if the floodway fringe were to be completely filled in. It was found that an acceptable floodway could not be established in the ponded area of Rio de Flag, so the floodplain delineation was also established as the floodway limit.

Floodways were initially determined using equal conveyance and refined using Method 1 encroachment stations.

No floodways were computed for a portion of Clay Avenue Wash, Clay Avenue Wash Split Flow, Fanning Drive Wash, Rio de Flag Split Flow, Spruce Avenue Wash, or West Street Wash.

The culvert on Fanning Drive Wash at the railroad has a small capacity compared to the entire flow; therefore, a weir equation was used to determine the backwater elevation behind the railroad embankment. No floodway is shown for this area.

The floodway limits were defined by initially using Method 4 with a surcharge of 1.0 foot, and then running the model. Modifications were made as needed to insure the surcharge did not exceed 1.0 foot, and velocities did not significantly increase. After these modifications were made, Method 1 was used with the known encroachment stations obtained from Method 4. The output was checked again and the floodway inundation limits were defined based on these new encroachment boundaries.

Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 9). The computed floodways are shown on the FIRM. In cases where the floodway and 1-percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 9, "Floodway Data." In order to reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 9 for certain downstream cross sections of Switzer Canyon Wash are lower than the regulatory flood elevations in that area, which must take into account the 1-percent annual chance flooding due to backwater from other sources.

The area between the floodway and 1-percent annual chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent annual chance flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

Floodway widths extend beyond the Coconino County boundary for Kanab Creek.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Baderville Tributary to Rio De Flag								
A	1,940	107	259	1.5	7,304.1	7,304.1	7,305.1	1.0
B	2,795	86	97	4.0	7,305.9	7,305.9	7,306.9	1.0
C	3,212	157	177	2.2	7,307.8	7,307.8	7,308.8	1.0
D	3,270	102	361	1.1	7,311.1	7,311.1	7,311.8	0.7
E	3,585	55	198	2.0	7,311.1	7,311.1	7,311.8	0.7
F	4,230	66	157	1.4	7,311.2	7,311.2	7,312.2	1.0
G	4,870	60	40	5.6	7,314.0	7,314.0	7,314.2	0.2
H	4,916	51	116	1.9	7,315.7	7,315.7	7,316.6	0.9
I	5,845	50	97	2.3	7,316.5	7,316.5	7,317.3	0.8
J	6,255	35	59	3.8	7,318.1	7,318.1	7,318.6	0.5
K	7,280	32	51	2.9	7,322.6	7,322.6	7,323.6	1.0
L	8,150	22	37	4.1	7,327.1	7,327.1	7,328.1	1.0

[1] Feet above confluence with Rio de Flag

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

BADERVILLE TRIBUTARY TO RIO DE FLAG

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Bow and Arrow Wash								
A	317	57	199	2.1	6,801.6	6,801.6	6,802.6	1.0
B	792	57	67	6.2	6,804.0	6,804.0	6,804.2	0.2
C	1,267	65	105	4.0	6,807.3	6,807.3	6,807.7	0.4
D	1,742	56	67	6.2	6,812.0	6,812.0	6,812.0	0.0
E	2,218	63	78	5.3	6,817.0	6,817.0	6,817.0	0.0
F	2,482	45	102	4.1	6,818.6	6,818.6	6,818.7	0.1
G	2,798	42	60	6.9	6,820.8	6,820.8	6,820.8	0.0
H	3,221	44	94	4.4	6,823.9	6,823.9	6,823.9	0.0
I	3,802	57	67	6.2	6,830.1	6,830.1	6,830.2	0.1
J	3,960	65	102	4.1	6,831.9	6,831.9	6,832.1	0.2
K	4,330	43	61	6.8	6,834.9	6,834.9	6,834.9	0.0
L	5,227	32	70	4.6	6,841.7	6,841.7	6,841.9	0.2
M	5,597	16	37	8.6	6,847.2	6,847.2	6,847.2	0.0
N	6,230	40	94	3.4	6,849.9	6,849.9	6,850.6	0.7
O	6,758	22	41	7.8	6,857.2	6,857.2	6,857.2	0.0
P	7,603	20	60	5.4	6,863.2	6,863.2	6,864.2	1.0
Q	7,920	16	37	8.7	6,866.1	6,866.1	6,866.5	0.4
R	8,237	58	120	2.7	6,868.3	6,868.3	6,868.9	0.6
S	8,659	27	44	7.3	6,872.5	6,872.5	6,872.5	0.0
T	8,818	23	42	7.7	6,876.2	6,876.2	6,876.2	0.0
U	8,971	41	146	2.2	6,878.4	6,878.4	6,878.5	0.1
V	9,086	39	252	1.3	6,883.2	6,883.2	6,883.7	0.5
W	9,213	55	277	1.2	6,883.2	6,883.2	6,883.8	0.6
X	9,890	46	80	4.0	6,885.0	6,885.0	6,885.0	0.0
Y	10,081	55	94	3.4	6,886.3	6,886.3	6,886.4	0.1
Z	10,532	67	121	2.6	6,888.3	6,888.3	6,888.4	0.1
AA	10,982	78	114	2.1	6,890.1	6,890.1	6,890.1	0.0

[1] Feet above confluence with Rio de Flag

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

BOW AND ARROW WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Bow and Arrow Wash (Cont'd)								
AB	11,112	61	64	3.8	6,890.8	6,890.8	6,890.9	0.1
AC	11,257	46	81	3.0	6,891.3	6,891.3	6,891.6	0.3
AD	11,392	42	80	3.0	6,891.6	6,891.6	6,892.2	0.6
AE	11,484	33	53	4.6	6,891.9	6,891.9	6,892.7	0.8
AF	11,519	40	82	2.9	6,892.3	6,892.3	6,893.1	0.8
AG	11,704	44	103	2.4	6,893.0	6,893.0	6,893.7	0.7
AH	11,747	41	71	3.4	6,893.1	6,893.1	6,893.8	0.7
AI	11,884	53	87	2.8	6,893.7	6,893.7	6,894.3	0.6
AJ	12,011	34	59	4.1	6,894.3	6,894.3	6,895.0	0.7
AK	12,101	41	70	3.5	6,894.6	6,894.6	6,895.2	0.6
AL	12,192	39	86	2.8	6,895.2	6,895.2	6,896.0	0.8
AM	12,361	32	40	6.1	6,895.5	6,895.5	6,896.0	0.5
AN	12,476	52	109	2.2	6,896.0	6,896.0	6,896.7	0.7
AO	12,583	43	76	3.2	6,896.2	6,896.2	6,896.8	0.6
AP	12,743	40	47	4.1	6,896.7	6,896.7	6,897.0	0.3
AQ	12,844	41	56	3.4	6,897.5	6,897.5	6,897.7	0.2
AR	12,896	42	89	2.2	6,898.0	6,898.0	6,898.5	0.5
AS	13,000	34	47	4.1	6,898.1	6,898.1	6,898.9	0.8
AT	13,043	38	89	2.2	6,898.5	6,898.5	6,899.2	0.7
AU	13,195	41	71	2.7	6,898.7	6,898.7	6,899.5	0.8
AV	13,285	43	72	2.1	6,899.4	6,899.4	6,899.9	0.5
AW	13,494	39	72	2.1	6,900.7	6,900.7	6,901.3	0.6
AX	13,557	43	62	2.5	6,900.8	6,900.8	6,901.3	0.5
AY	13,727	37	51	3.0	6,902.3	6,902.3	6,902.6	0.3
AZ	13,960	47	70	2.2	6,903.4	6,903.4	6,903.8	0.4
BA	14,226	36	30	5.3	6,904.9	6,904.9	6,905.0	0.1
BB	14,515	40	38	4.1	6,907.7	6,907.7	6,907.7	0.0
BC	14,932	79	53	2.9	6,912.9	6,912.9	6,912.9	0.0

[1] Feet above confluence with Rio de Flag

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

BOW AND ARROW WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Bow and Arrow Wash (Cont'd)								
BD	15,206	47	38	4.1	6,915.1	6,915.1	6,915.1	0.0
BE	15,663	24	25	5.8	6,918.2	6,918.2	6,918.2	0.0
BF	16,326	82	68	2.2	6,924.4	6,924.4	6,924.7	0.3
BG	16,762	72	71	2.1	6,927.8	6,927.8	6,927.9	0.1
BH	16,917	57	60	2.4	6,930.9	6,930.9	6,930.9	0.0
BI	17,448	72	39	3.5	6,932.4	6,932.4	6,932.4	0.0
BJ	17,899	43	38	3.6	6,939.5	6,939.5	6,939.5	0.0
BK	18,462	46	37	3.7	6,946.7	6,946.7	6,946.7	0.0
BL	18,725	30	39	3.5	6,949.3	6,949.3	6,949.3	0.0

[1] Feet above confluence with Rio de Flag

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

BOW AND ARROW WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Cataract Creek								
A	634	86	524	7.4	6,707.8	6,707.8	6,708.5	0.7
B	1,478	86	661	8.3	6,715.2	6,715.2	6,715.6	0.4
C	2,429	89	616	6.3	6,717.7	6,717.7	6,718.6	0.9
D	3,432	330	2,069	3.0	6,725.1	6,725.1	6,725.1	0.0
E	4,424	170	842	4.6	6,726.0	6,726.0	6,726.2	0.2
F	5,227	130	1,125	3.6	6,732.6	6,732.6	6,733.6	1.0
G	6,252	250	987	3.7	6,733.3	6,733.3	6,734.2	0.9
H	6,542	44	234	3.3	6,733.7	6,733.7	6,734.6	0.9
I	6,964	44	155	4.9	6,734.3	6,734.3	6,734.8	0.5
J	7,096	29	66	8.6	6,736.4	6,736.4	6,736.4	0.0
K	7,572	35	97	5.9	6,742.7	6,742.7	6,742.8	0.1
L	8,205	33	89	6.4	6,748.2	6,748.2	6,748.3	0.1
M	8,311	100	279	2.5	6,750.6	6,750.6	6,751.3	0.7
N	8,575	80	151	4.5	6,751.5	6,751.5	6,751.8	0.3
O	9,103	40	106	6.4	6,754.0	6,754.0	6,754.0	0.0
P	9,314	45	120	6.9	6,757.9	6,757.9	6,757.9	0.0
Q	9,895	44	109	7.6	6,764.2	6,764.2	6,764.2	0.0
R	10,000	57	106	7.8	6,768.6	6,768.6	6,768.6	0.0
S	10,212	35	107	7.7	6,771.2	6,771.2	6,771.3	0.1
T	10,317	49	167	4.9	6,772.7	6,772.7	6,772.8	0.1
U	10,423	51	198	4.2	6,773.3	6,773.3	6,773.4	0.1
V	10,528	38	169	5.0	6,774.6	6,774.6	6,774.6	0.0
W	10,740	47	157	5.4	6,775.1	6,775.1	6,775.5	0.4
X	10,845	75	292	3.1	6,777.6	6,777.6	6,778.6	1.0
Y	11,109	46	105	8.6	6,779.9	6,779.9	6,779.9	0.0
Z	11,215	73	361	2.5	6,784.0	6,784.0	6,785.0	1.0
AA	11,479	52	112	8.1	6,785.0	6,785.0	6,785.1	0.1
AB	11,584	91	389	2.3	6,787.9	6,787.9	6,788.9	1.0

[1] Feet above confluence with Santa Fe Wash East

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

CATARACT CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Cataract Creek (Cont'd)								
AC	11,848[1]	40	108	8.3	6,792.3	6,792.3	6,792.5	0.2
AD	11,954[1]	95	369	2.7	6,796.2	6,796.2	6,797.1	0.9
AE	12,218[1]	70	315	3.5	6,801.2	6,801.2	6,801.6	0.4
AF	12,588[1]	25	99	11.2	6,805.4	6,805.4	6,805.7	0.3
AG	12,957[1]	40	135	8.2	6,815.3	6,815.3	6,816.3	1.0
AH	13,380[1]	57	115	8.2	6,824.6	6,824.6	6,824.6	0.0
AI	13,538[1]	413	2,213	0.5	6,876.8	6,876.8	6,876.8	0.0
AJ	14,330[1]	320	1,603	0.7	6,876.8	6,876.8	6,876.8	0.0
AK	15,175[1]	255	1,266	0.9	6,876.8	6,876.8	6,876.8	0.0
AL	15,861[1]	116	419	2.6	6,876.8	6,876.8	6,876.8	0.0
AM	16,231[1]	65	153	7.2	6,882.9	6,882.9	6,882.9	0.0
Cataract Creek Tributary								
A	7,603[2]	55	38	4.8	6,823.7	6,823.7	6,823.7	0.0
B	8,131[2]	27	30	6.1	6,843.0	6,843.0	6,843.0	0.0
C	8,976[2]	195	3,875	0.1	6,898.4	6,898.4	6,898.4	0.0
D	9,398[2]	190	2,196	0.1	6,898.4	6,898.4	6,898.4	0.0
E	9,874[2]	103	495	0.4	6,898.4	6,898.4	6,898.4	0.0
F	10,085[2]	41	78	2.4	6,898.4	6,898.4	6,898.4	0.0
G	10,454[2]	25	30	6.2	6,904.6	6,904.6	6,904.6	0.0
H	10,507[2]	19	27	6.8	6,909.2	6,909.2	6,909.2	0.0
I	10,771[2]	43	38	4.9	6,916.2	6,916.2	6,916.2	0.0
J	11,194[2]	475	7,120	0.1	6,983.5	6,983.5	6,983.5	0.0
K	11,880[2]	287	2,299	0.2	6,983.5	6,983.5	6,983.5	0.0
L	12,038[2]	69	100	4.8	6,983.5	6,983.5	6,983.5	0.0

[1] Feet above confluence with Santa Fe Wash East

[2] Feet above confluence with West Cataract Creek

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

CATARACT CREEK-CATARACT CREEK TRIBUTARY

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Cemetary Wash								
A	739[1]	1,005	1,581	0.2	6,744.2	6,744.2	6,744.2	0.0
B	1,109[1]	25	48	8.0	6,745.1	6,745.1	6,745.5	0.4
C	2,112[1]	111	97	4.0	6,758.7	6,758.7	6,759.4	0.7
D	2,218[1]	34	53	7.2	6,762.3	6,762.3	6,763.2	0.9
E	2,693[1]	31	65	5.9	6,767.8	6,767.8	6,768.0	0.2
F	3,062[1]	25	48	8.0	6,772.1	6,772.1	6,772.5	0.4
G	3,274[1]	60	202	1.9	6,776.3	6,776.3	6,776.3	0.0
H	3,379[1]	108	341	1.1	6,781.7	6,781.7	6,781.7	0.0
I	3,802[1]	65	69	5.6	6,784.5	6,784.5	6,784.5	0.0
J	3,907[1]	25	52	7.4	6,786.4	6,786.4	6,786.4	0.0
K	4,382[1]	38	61	6.3	6,793.7	6,793.7	6,793.7	0.0
L	4,541[1]	38	61	6.3	6,797.4	6,797.4	6,797.4	0.0
M	4,910[1]	43	64	6.0	6,805.2	6,805.2	6,805.2	0.0
Clay Avenue Wash								
A	1,584[2]	75	287	1.6	6,897.8	6,897.8	6,898.8	1.0
B	2,038[2]	198	108	4.2	6,898.3	6,898.3	6,899.3	1.0
C	2,244[2]	158	143	3.1	6,901.9	6,901.9	6,901.9	0.0
D	2,524[2]	314	206	2.2	6,901.9	6,901.9	6,902.7	0.8
E	2,767[2]	380	142	3.2	6,903.6	6,903.6	6,903.6	0.0
F	3,084[2]	220	206	2.2	6,903.9	6,903.9	6,904.7	0.8
G	3,691[2]	34	62	7.2	6,911.0	6,911.0	6,911.8	0.8
H	4,330[2]	14	45	10.1	6,928.1	6,928.1	6,928.8	0.7
I	4,884[2]	27	117	3.9	6,934.6	6,934.6	6,935.4	0.8
J-Z*								

[1] Feet above confluence with West Cataract Creek
[2] Feet above confluence with Rio de Flag
* Floodway Data Not Computed

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

CEMETARY WASH – CLAY AVENUE WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Country Club Wash								
A	1,848	529	3,037	0.0	6,768.5	6,768.5	6,768.5	0.0
B	2,482	476	1,893	0.1	6,768.5	6,768.5	6,768.5	0.0
C	2,798	292	630	0.2	6,768.5	6,768.5	6,768.5	0.0
D	2,851	20	20	5.7	6,770.9	6,770.9	6,770.9	0.0
E	2,904	151	316	0.4	6,771.5	6,771.5	6,771.5	0.0
F	3,221	49	135	0.8	6,771.5	6,771.5	6,771.5	0.0
G	3,538	158	443	0.3	6,771.5	6,771.5	6,771.5	0.0
H	3,590	24	39	2.9	6,771.5	6,771.5	6,771.5	0.0
I	3,696	35	41	1.9	6,771.7	6,771.7	6,771.7	0.0
J	4,171	17	15	5.3	6,775.0	6,775.0	6,775.0	0.0
K	4,330	30	18	4.4	6,780.4	6,780.4	6,780.6	0.2
L	4,594	30	24	3.1	6,783.4	6,783.4	6,783.7	0.3
M	5,069	30	46	1.7	6,784.4	6,784.4	6,784.7	0.3
N	5,174	13	13	5.7	6,784.6	6,784.6	6,784.6	0.0
O	5,650	20	18	2.9	6,789.9	6,789.9	6,790.0	0.1
Fanning Drive Wash								
A	613	140	1,131	2.7	6,787.5	6,787.5	6,788.5	1.0
B	803	39	147	5.0	6,787.5	6,787.5	6,788.5	1.0
C	1,109	30	79	9.2	6,791.1	6,791.1	6,791.4	0.3
D	1,510	60	155	4.6	6,801.5	6,801.5	6,802.5	1.0
E	2,677	45	120	6.0	6,821.6	6,821.6	6,822.0	0.4
F	3,369	50	123	5.9	6,828.0	6,828.0	6,828.2	0.2
G	3,781	38	86	8.4	6,834.0	6,834.0	6,834.6	0.6
H	3,960	50	129	5.6	6,834.0	6,834.0	6,834.6	0.6
I	4,430	50	97	7.4	6,836.5	6,836.5	6,837.4	0.9
J-AG*								

[1] Feet above confluence with Rio de Flag

* Floodway Data Not Computed

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

COUNTRY CLUB WASH – FANNING DRIVE WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Howard Draw Wash								
A	370	740	10,547	0.4	6,810.6	6,810.6	6,811.4	0.8
B	739	650	9,000	0.5	6,810.6	6,810.6	6,811.4	0.8
C	1,214	810	10,000	0.5	6,810.6	6,810.6	6,811.4	0.8
D	1,954	470	4,535	1.0	6,810.6	6,810.6	6,811.4	0.8
E	2,534	515	3,674	1.2	6,810.6	6,810.6	6,811.4	0.8
F	2,957	365	2,185	2.1	6,810.6	6,810.6	6,811.4	0.8
G	3,749	235	613	7.4	6,811.9	6,811.9	6,812.7	0.8
H	4,382	230	1,164	3.9	6,814.6	6,814.6	6,815.5	0.9
I	5,069	260	1,102	4.1	6,815.9	6,815.9	6,816.7	0.8
J	5,597	230	1,052	4.1	6,817.2	6,817.2	6,818.0	0.8
K	6,494	120	569	7.5	6,819.9	6,819.9	6,820.6	0.7
L	7,075	250	1,791	2.4	6,821.4	6,821.4	6,822.2	0.8
M	7,867	150	760	5.6	6,821.6	6,821.6	6,822.4	0.8
N	8,342	180	580	7.4	6,823.4	6,823.4	6,823.9	0.5
O	9,029	260	1,194	3.6	6,826.1	6,826.1	6,826.9	0.8
P	9,240	240	951	4.5	6,826.7	6,826.7	6,827.3	0.6
Q	9,451	300	575	7.4	6,827.6	6,827.6	6,828.2	0.6
R	9,715	305	1,157	3.7	6,829.3	6,829.3	6,830.2	0.9
S	9,874	250	1,017	4.2	6,829.9	6,829.9	6,830.6	0.7
T	10,454	130	455	8.9	6,831.7	6,831.7	6,832.0	0.3

[1] Feet above Limit of Detailed Study (Limit of Detailed Study is approximately 750 feet downstream of first road crossing)

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

HOWARD DRAW WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)[2]	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Kanab Creek								
A	230,683	106	1,490	7.0	4,664.4	4,664.4	4,665.2	0.8
B	231,264	114	1,910	5.5	4,665.2	4,665.2	4,666.1	0.9
C	231,845	58	1,050	10.0	4,665.2	4,665.2	4,666.1	0.9
D	232,267	80	1,005	10.4	4,665.4	4,665.4	4,666.2	0.8
E	232,478	69	840	12.5	4,665.4	4,665.4	4,666.2	0.8
F	233,006	47	679	15.5	4,667.5	4,667.5	4,668.0	0.5
G	233,851	88	1,032	10.2	4,672.6	4,672.6	4,672.7	0.1
H	234,854	75	637	16.5	4,674.4	4,674.4	4,674.4	0.0
I	235,541	96	1,408	7.5	4,680.0	4,680.0	4,680.0	0.0
J	236,438	114	721	14.6	4,682.0	4,682.0	4,682.0	0.0
K	237,072	236	1,246	8.4	4,687.3	4,687.3	4,687.3	0.0
L	237,125	254	1,778	5.9	4,696.9	4,696.9	4,696.9	0.0
M	237,178	140	780	13.5	4,696.9	4,696.9	4,696.9	0.0
N	237,389	235	1,516	6.9	4,698.9	4,698.9	4,698.9	0.0
O	238,181	200	1,016	10.3	4,700.7	4,700.7	4,700.7	0.0
P	238,920	205	1,168	9.0	4,704.5	4,704.5	4,705.1	0.6
Q	239,554	110	1,008	10.4	4,706.1	4,706.1	4,707.1	1.0
R	240,557	158	1,613	6.5	4,709.2	4,709.2	4,710.1	0.9

[1] Feet above confluence with Colorado River
[2] Width extends beyond county boundary

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

KANAB CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Munds Canyon Creek								
A	317	120	986	14.7	4,581.7	4,581.7	4,581.7	0.0
B	1,109	130	1,020	14.2	4,615.1	4,615.1	4,615.6	0.5
C	1,795	150	1,078	13.5	4,642.3	4,642.3	4,642.3	0.0
D	2,534	140	1,050	13.8	4,670.1	4,670.1	4,670.1	0.0
Munds Park Wash								
A	32,419	79	946	13.8	6,458.1	6,458.1	6,458.5	0.4
B	32,736	245	2,791	4.7	6,461.7	6,461.7	6,462.4	0.7
C	33,422	620	7,096	0.9	6,462.3	6,462.3	6,463.0	0.7
D	35,323	700	4,029	1.6	6,462.3	6,462.3	6,463.0	0.7
E	36,326	200	1,014	5.8	6,462.3	6,462.3	6,463.3	1.0
F	37,752	132	565	10.5	6,466.3	6,466.3	6,466.7	0.4
G	38,122	666	8,018	0.7	6,479.1	6,479.1	6,479.1	0.0
H	38,914	1,075	13,166	0.4	6,479.1	6,479.1	6,479.1	0.0
I	39,494	380	1,553	3.8	6,479.1	6,479.1	6,479.1	0.0
J	39,811	175	494	12.0	6,481.8	6,481.8	6,481.8	0.0
K	40,550	127	512	11.5	6,493.2	6,493.2	6,493.2	0.0
L	40,762	85	451	13.1	6,499.4	6,499.4	6,499.4	0.0
M	41,131	117	498	11.9	6,505.0	6,505.0	6,505.0	0.0
N	41,765	116	540	10.9	6,516.5	6,516.5	6,516.5	0.0
O	42,187	86	432	13.7	6,525.1	6,525.1	6,525.1	0.0
P	42,610	91	437	13.5	6,532.3	6,532.3	6,532.3	0.0
Q	43,085	91	458	12.9	6,544.6	6,544.6	6,544.6	0.0
R	44,088	76	433	13.7	6,570.7	6,570.7	6,570.7	0.0

[1] Feet above confluence with Oak Creek

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

MUNDS CANYON CREEK-MUNDS PARK WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Oak Creek								
A	175,138	368	3,802	7.1	4,095.9	4,095.9	4,095.9	0.0
B	175,560	375	2,996	9.0	4,100.8	4,100.8	4,100.8	0.0
C	176,141	455	3,298	8.2	4,105.6	4,105.6	4,105.6	0.0
D	177,144	399	3,375	8.0	4,112.4	4,112.4	4,112.4	0.0
E	177,989	380	3,132	8.6	4,118.4	4,118.4	4,118.4	0.0
F	178,939	477	2,856	9.4	4,129.3	4,129.3	4,129.3	0.0
G	180,101	448	2,958	9.1	4,142.7	4,142.7	4,142.7	0.0
H	181,210	379	2,523	10.7	4,153.6	4,153.6	4,154.2	0.6
I	182,054	240	2,482	10.8	4,164.0	4,164.0	4,164.8	0.8
J	182,952	394	2,961	9.1	4,172.1	4,172.1	4,172.3	0.2
K	183,902	343	2,672	10.1	4,183.0	4,183.0	4,184.0	1.0
L	184,589	386[2]	1,995	13.5	4,190.4	4,190.4	4,190.9	0.5
M	185,328	141	2,187	12.4	4,196.0	4,196.0	4,196.8	0.8
N	185,434	337	4,413	6.2	4,202.7	4,202.7	4,202.8	0.1
O	186,226	563	3,638	7.5	4,205.8	4,205.8	4,205.8	0.0
P	187,176	402	2,449	11.1	4,216.1	4,216.1	4,216.1	0.0
Q	188,232	249	2,492	14.5	4,229.8	4,229.8	4,230.1	0.3
R	189,130	208	2,235	16.3	4,238.5	4,238.5	4,239.0	0.5
S	190,133	435	3,889	7.3	4,252.9	4,252.9	4,252.9	0.0
T	191,199	390	2,743	10.4	4,264.0	4,264.0	4,264.0	0.0
U	192,219	193	2,106	15.9	4,278.2	4,278.2	4,278.5	0.3
V	193,222	290	3,349	8.2	4,288.5	4,288.5	4,289.5	1.0
W	194,120	260	2,131	12.9	4,295.4	4,295.4	4,295.4	0.0
X	203,914	365	2,902	9.6	4,447.5	4,447.5	4,447.5	0.0
Y	205,075	504	3,878	7.2	4,460.3	4,460.3	4,460.3	0.0
Z	205,867	495	2,473	11.3	4,474.0	4,474.0	4,474.0	0.0
AA	206,554	283	2,723	10.3	4,487.4	4,487.4	4,487.7	0.3
AB	207,398	295	2,926	9.5	4,508.5	4,508.5	4,508.9	0.4

[1] Feet above confluence with Verde River
[2] Combined floodway Oak Creek/Soldier Wash

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

OAK CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Oak Creek (Cont'd)								
AC	207,821	244	2,965	9.4	4,521.0	4,521.0	4,521.2	0.2
AD	207,979	225	2,982	9.4	4,521.9	4,521.9	4,522.6	0.7
AE	208,666	316	4,276	6.5	4,532.2	4,532.2	4,532.8	0.6
AF	209,933	275	2,358	11.8	4,554.3	4,554.3	4,554.3	0.0
AG	210,778	237	2,365	11.8	4,568.6	4,568.6	4,568.8	0.2
AH	211,253	161	1,364	12.6	4,576.1	4,576.1	4,576.1	0.0
AI	212,150	119	1,052	16.3	4,596.3	4,596.3	4,596.3	0.0
AJ	212,678	104	1,024	16.7	4,609.4	4,609.4	4,608.8	0.0
AK	213,206	157	1,424	12.0	4,620.1	4,620.1	4,620.9	0.8
AL	213,312	153	1,248	13.7	4,623.6	4,623.6	4,623.6	0.0
AM	213,787	173	1,693	10.1	4,633.4	4,633.4	4,633.6	0.2
AN	214,368	169	1,295	13.2	4,646.6	4,646.6	4,646.6	0.0
AO	214,896	143	1,152	14.9	4,661.7	4,661.7	4,661.8	0.1
AP	223,238	265	1,512	11.1	4,808.9	4,808.9	4,808.9	0.0
AQ	224,347	342	2,179	7.7	4,828.6	4,828.6	4,828.6	0.0
AR	225,245	88	957	17.5	4,843.1	4,843.1	4,843.1	0.0
AS	225,878	102	1,209	13.8	4,857.5	4,857.5	4,857.5	0.0
AT	226,723	130	1,045	16.0	4,873.4	4,873.4	4,873.4	0.0
AU	227,621	73	1,028	16.3	4,892.2	4,892.2	4,892.2	0.0
AV	227,779	57	788	21.2	4,895.4	4,895.4	4,895.4	0.0
AW	228,518	94	1,173	14.2	4,915.0	4,915.0	4,915.0	0.0
AX	229,258	113	1,088	15.4	4,928.7	4,928.7	4,928.7	0.0
AY	229,838	89	1,075	15.5	4,940.9	4,940.9	4,940.9	0.0
AZ	230,578	77	869	19.2	4,967.6	4,967.6	4,967.6	0.0
BA	231,475	127	1,578	10.6	4,984.5	4,984.5	4,984.5	0.0
BB	232,690	187	1,248	13.4	5,010.3	5,010.3	5,010.3	0.0
BC	233,429	123	1,031	16.2	5,029.7	5,029.7	5,029.7	0.0
BD	234,221	251	1,467	11.4	5,051.7	5,051.7	5,051.7	0.0

[1] Feet above confluence with Verde River

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

OAK CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Peak View Wash								
A	68	14	9	2.2	7,112.8	7,112.8	7,112.8	0.0
B	224	12	52	2.0	7,113.0	7,113.0	7,113.1	0.1
C	284	19	69	1.5	7,113.1	7,113.1	7,113.2	0.1
D	421	13	55	1.9	7,113.2	7,113.2	7,113.3	0.1
E	561	18	64	1.6	7,113.3	7,113.3	7,113.4	0.1
F	700	18	56	1.9	7,113.9	7,113.9	7,114.0	0.1
G	755	22	54	2.0	7,114.0	7,114.0	7,114.1	0.1
H	836	17	48	2.2	7,114.1	7,114.1	7,114.1	0.0
I	941	19	66	1.6	7,115.3	7,115.3	7,115.3	0.0
J	1,009	26	16	6.5	7,115.3	7,115.3	7,115.3	0.0
K	1,121	24	24	4.4	7,118.4	7,118.4	7,118.4	0.0
L	1,196	14	45	2.3	7,121.1	7,121.1	7,121.1	0.0
M	1,234	28	23	4.6	7,121.6	7,121.6	7,121.7	0.1
N	1,278	47	27	3.9	7,122.6	7,122.6	7,122.6	0.0

[1] Feet above confluence with Rio de Flag

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

PEAK VIEW WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Penstock Avenue Wash								
A	158	24	99	1.4	6,770.8	6,770.8	6,771.8	1.0
B	422	28	45	3.1	6,772.0	6,772.0	6,772.3	0.3
C	634	30	34	4.1	6,772.1	6,772.1	6,772.7	0.6
D	797	30	40	3.5	6,773.7	6,773.7	6,774.5	0.8
E	1,172	30	184	0.7	6,773.8	6,773.8	6,774.8	1.0
F	1,478	18	21	6.2	6,774.7	6,774.7	6,774.7	0.0
G	1,790	14	25	5.2	6,777.7	6,777.7	6,778.1	0.4
H	1,890	15	20	6.6	6,779.9	6,779.9	6,779.9	0.0
I	2,186	20	22	5.9	6,782.5	6,782.5	6,782.5	0.0
J	2,371	36	52	2.1	6,783.6	6,783.6	6,784.1	0.5
K	2,693	30	24	4.6	6,784.1	6,784.1	6,784.5	0.4
L	3,136	30	24	4.6	6,785.9	6,785.9	6,786.3	0.4
M	3,284	19	20	5.1	6,787.3	6,787.3	6,787.3	0.0
N	3,416	18	18	5.5	6,788.2	6,788.2	6,788.2	0.0
O	3,680	23	34	2.5	6,789.5	6,789.5	6,789.5	0.0
P	3,860	22	43	2.0	6,791.4	6,791.4	6,791.4	0.0
Q	3,965	15	15	5.7	6,795.4	6,795.4	6,795.4	0.0
R	4,150	24	41	1.7	6,796.3	6,796.3	6,796.3	0.0
S	4,425	13	22	3.2	6,799.3	6,799.3	6,799.3	0.0
T	4,536	24	48	1.2	6,802.5	6,802.5	6,802.5	0.0
U	4,704	20	35	1.7	6,804.0	6,804.0	6,804.0	0.0
V	4,873	14	15	3.8	6,809.9	6,809.9	6,809.9	0.0
W	5,064	13	11	5.2	6,812.7	6,812.7	6,812.7	0.0
X-Z*								

[1] Feet above confluence with Rio de Flag

* Data Not Available

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

PENSTOCK AVENUE WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Rio De Flag								
A	15,307	101	572	7.8	6,525.3	6,525.3	6,526.3	1.0
B	16,336	91	595	7.5	6,530.4	6,530.4	6,531.3	0.9
C	17,041	70	394	8.9	6,533.5	6,533.5	6,533.8	0.3
D	18,064	59	533	6.6	6,538.8	6,538.8	6,539.4	0.6
E	18,738	67	299	11.7	6,540.7	6,540.7	6,540.7	0.0
F	19,697	68	457	7.7	6,546.7	6,546.7	6,547.2	0.5
G	20,531	69	423	8.3	6,549.3	6,549.3	6,550.2	0.9
H	21,786	52	331	10.6	6,558.5	6,558.5	6,559.5	1.0
I	21,922	72	764	4.6	6,563.5	6,563.5	6,564.5	1.0
J	22,399	46	454	7.7	6,563.7	6,563.7	6,564.6	0.9
K	23,677	91	399	8.8	6,569.5	6,569.5	6,570.0	0.5
L	24,493	96	416	8.4	6,581.5	6,581.5	6,581.7	0.2
M	26,705	69	371	9.4	6,605.1	6,605.1	6,605.7	0.6
N	27,500	171	467	7.5	6,612.7	6,612.7	6,613.1	0.4
O	27,669	137	1,593	2.1	6,624.5	6,624.5	6,625.4	0.9
P	30,716	668	2,685	1.3	6,624.8	6,624.8	6,625.7	0.9
Q	31,755	427	840	4.0	6,625.3	6,625.3	6,626.2	0.9
R	34,749	84	593	5.7	6,641.5	6,641.5	6,642.5	1.0
S	36,090	46	252	13.4	6,682.6	6,682.6	6,682.8	0.2
T	36,913	103	586	5.8	6,736.5	6,736.5	6,736.9	0.4
U	37,334	156	861	3.9	6,737.9	6,737.9	6,738.2	0.3
V	37,865	167	1,002	3.4	6,738.5	6,738.5	6,739.0	0.5
W	39,292	116	539	6.3	6,740.0	6,740.0	6,740.9	0.9
X	39,660	169	1,901	1.8	6,749.2	6,749.2	6,749.4	0.2
Y	40,946	243	3,159	1.1	6,758.0	6,758.0	6,758.2	0.2
Z	41,042	255	3,695	0.9	6,758.0	6,758.0	6,758.2	0.2
AA	44,649	93	1,035	3.1	6,758.4	6,758.4	6,758.6	0.2

[1] Feet above confluence with San Francisco Wash

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

RIO DE FLAG

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Rio De Flag (Cont'd)								
AB	45,794	171	2,395	1.4	6,768.5	6,768.5	6,768.5	0.0
AC	46,955	848	8,405	0.4	6,768.5	6,768.5	6,768.5	0.0
AD	48,275	833	11,670	0.3	6,768.5	6,768.5	6,768.5	0.0
AE	49,701	786	10,110	0.3	6,768.5	6,768.5	6,768.5	0.0
AF	50,651	1,813	21,512	0.2	6,768.5	6,768.5	6,768.5	0.0
AG	52,605	890	9,410	0.3	6,768.5	6,768.5	6,768.5	0.0
AH	54,136	1,297	7,133	0.5	6,768.7	6,768.7	6,768.7	0.0
AI	54,981	462	1,736	1.9	6,768.7	6,768.7	6,768.7	0.0
AJ	55,403	194	520	6.3	6,768.7	6,768.7	6,768.7	0.0
AK	55,509	399	1,373	2.4	6,772.0	6,772.0	6,772.0	0.0
AL	56,195	346	2,168	1.5	6,772.1	6,772.1	6,772.1	0.0
AM	57,410	579	2,684	1.2	6,772.3	6,772.3	6,772.3	0.0
AN	58,835	251	1,037	3.1	6,772.5	6,772.5	6,772.5	0.0
AO	59,786	146	416	7.8	6,772.9	6,772.9	6,773.4	0.5
AP	60,630	245	966	3.4	6,775.4	6,775.4	6,776.1	0.7
AQ	62,162	129	465	7.0	6,777.5	6,777.5	6,778.3	0.8
AR	62,426	53	339	9.6	6,778.1	6,778.1	6,779.1	1.0
AS	62,690	90	450	7.4	6,779.4	6,779.4	6,780.3	0.9
AT	62,954	382	862	3.8	6,781.9	6,781.9	6,782.0	0.1
AU	63,746	285	1,195	2.7	6,782.5	6,782.5	6,782.6	0.1
AV	64,907	146	573	5.7	6,782.7	6,782.7	6,783.1	0.4
AW	65,594	166	461	7.1	6,786.2	6,786.2	6,786.9	0.7
AX	66,227	216	947	3.4	6,788.2	6,788.2	6,789.2	1.0
AY	66,755	137	661	4.9	6,788.9	6,788.9	6,789.8	0.9
AZ	67,125	180	820	4.0	6,789.3	6,789.3	6,790.3	1.0
BA	67,494	267	1,315	2.4	6,790.0	6,790.0	6,790.7	0.7
BB	68,339	304	1,626	1.9	6,790.3	6,790.3	6,791.0	0.7
BC	68,603	275	1,309	2.4	6,790.3	6,790.3	6,791.0	0.7

[1] Feet above confluence with San Francisco Wash

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

RIO DE FLAG

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Rio De Flag (Cont'd)								
BD	68,867	290	2,720	1.2	6,793.6	6,793.6	6,793.7	0.1
BE	69,501	160	1,427	2.2	6,793.7	6,793.7	6,793.7	0.0
BF	71,085	134	978	3.2	6,793.8	6,793.8	6,794.0	0.2
BG	72,827	210	1,564	2.0	6,794.1	6,794.1	6,794.5	0.4
BH	73,830	190	1,204	2.5	6,794.3	6,794.3	6,794.7	0.4
BI	74,306	240	1,455	2.1	6,794.4	6,794.4	6,794.9	0.5
BJ	75,837	340	1,470	2.1	6,794.6	6,794.6	6,795.3	0.7
BK	76,418	170	515	5.9	6,794.6	6,794.6	6,795.4	0.8
BL	77,790	125	639	4.8	6,798.0	6,798.0	6,798.8	0.8
BM	79,005	135	775	3.9	6,799.5	6,799.5	6,800.4	0.9
BN	79,744	60	372	8.2	6,800.1	6,800.1	6,800.9	0.8
BO	80,747	240	1,289	2.4	6,801.9	6,801.9	6,802.8	0.9
BP	81,064	209	1,042	2.6	6,802.1	6,802.1	6,802.9	0.8
BQ	81,275	40	208	13.0	6,806.6	6,806.6	6,806.6	0.0
BR	81,434	40	209	12.9	6,810.3	6,810.3	6,810.3	0.0
BS	81,750	166	1,811	1.5	6,813.9	6,813.9	6,813.9	0.0
BT	82,014	47	312	8.7	6,813.9	6,813.9	6,813.9	0.0
BU	82,701	210	2,493	1.1	6,814.9	6,814.9	6,815.0	0.1
BV	83,440	113	1,276	2.1	6,814.9	6,814.9	6,815.0	0.1
BW	84,074	91	680	4.0	6,814.9	6,814.9	6,815.0	0.1
BX	84,549	86	314	8.6	6,816.4	6,816.4	6,814.4	0.0
BY	84,918	103	712	3.8	6,818.5	6,818.5	6,818.6	0.1
BZ	85,394	74	276	9.8	6,820.3	6,820.3	6,820.3	0.0
CA	85,869	64	278	9.7	6,825.5	6,825.5	6,825.6	0.1
CB	86,872	90	322	8.4	6,842.3	6,842.3	6,842.3	0.0
CC	87,136	65	286	9.4	6,844.6	6,844.6	6,844.6	0.0
CD	87,717	63	353	7.7	6,847.8	6,847.8	6,848.6	0.8
CE	87,981	127	421	6.4	6,849.2	6,849.2	6,850.0	0.8

[1] Feet above confluence with San Francisco Wash

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

RIO DE FLAG

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Rio De Flag (Cont'd)								
CF	88,245	107	240	7.7	6,853.0	6,853.0	6,853.0	0.0
CG	88,562	91	222	8.3	6,861.0	6,861.0	6,861.0	0.0
CH	89,142	35	154	12.0	6,871.7	6,871.7	6,871.7	0.0
CI	89,723	51	139	9.8	6,881.5	6,881.5	6,881.5	0.0
CJ	90,040	145	300	6.2	6,887.9	6,887.9	6,887.9	0.0
CK	90,198	115	424	4.4	6,889.7	6,889.7	6,889.7	0.0
CL	90,304	110	246	7.5	6,889.7	6,889.7	6,889.7	0.0
CM	90,410	105	463	4.0	6,891.4	6,891.4	6,891.4	0.0
CN	90,568	102	268	6.9	6,891.8	6,891.8	6,891.8	0.0
CO	90,674	83	426	4.3	6,893.1	6,893.1	6,893.1	0.0
CP	91,466	215	1,114	1.7	6,894.7	6,894.7	6,895.5	0.8
CQ	91,730	245	942	2.0	6,895.1	6,895.1	6,896.1	1.0
CR	91,941	230	579	3.2	6,895.1	6,895.1	6,896.1	1.0
CS	92,099	215	405	3.6	6,896.1	6,896.1	6,897.0	0.9
CT	92,733	197	583	2.4	6,897.4	6,897.4	6,898.1	0.7
CU	92,838	190	500	2.8	6,897.6	6,897.6	6,898.3	0.7
CV	93,261	220	1,022	1.4	6,902.0	6,902.0	6,902.6	0.6
CW	93,525	105	840	1.7	6,905.3	6,905.3	6,905.7	0.4
CX	94,106	234	227	4.0	6,905.8	6,905.8	6,906.4	0.6
CY	94,422	200	754	1.9	6,907.5	6,907.5	6,907.7	0.2
CZ	94,739	200	1,096	1.3	6,907.8	6,907.8	6,908.4	0.6
DA	95,162	225	338	4.1	6,908.7	6,908.7	6,909.5	0.8
DB	95,426	235	431	3.2	6,910.8	6,910.8	6,911.6	0.8
DC	95,584	240	773	1.8	6,911.7	6,911.7	6,912.7	1.0
DD	95,848	166	281	5.0	6,914.4	6,914.4	6,914.7	0.3
DE	96,059	146	305	4.6	6,915.8	6,915.8	6,916.7	0.9
DF	96,218	104	286	4.9	6,918.2	6,918.2	6,918.2	0.0
DG	96,323	112	560	2.5	6,918.4	6,918.4	6,918.7	0.3

[1] Feet above confluence with San Francisco Wash

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

RIO DE FLAG

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Rio De Flag (Cont'd)								
DH	96,537	60	159	8.8	6,918.4	6,918.4	6,919.0	0.6
DI	96,904	242	249	5.6	6,932.0	6,932.0	6,932.3	0.3
DJ	97,326	149	572	2.4	6,932.8	6,932.8	6,933.5	0.7
DK	97,485	60	162	8.6	6,932.8	6,932.8	6,933.4	0.6
DL	97,749	45	213	6.6	6,934.7	6,934.7	6,935.7	1.0
DM	97,802	92	472	3.0	6,937.7	6,937.7	6,938.7	1.0
DN	98,382	47	140	10.0	6,939.5	6,939.5	6,939.5	0.0
DO	98,910	45	213	6.6	6,944.5	6,944.5	6,944.5	0.0
DP	99,069	72	330	4.2	6,946.8	6,946.8	6,946.8	0.0
DQ	99,438	30	121	11.6	6,948.0	6,948.0	6,948.0	0.0
DR	99,966	49	253	5.5	6,952.6	6,952.6	6,952.8	0.2
DS	100,283	21	108	13.0	6,953.7	6,853.7	6,853.7	0.0
DT	100,389	51	246	5.7	6,957.0	6,957.0	6,957.1	0.1
DU	100,706	53	202	6.9	6,958.1	6,958.1	6,958.1	0.0
DV	101,075	45	180	7.4	6,960.5	6,960.5	6,960.5	0.0
DW	101,498	37	172	7.8	6,963.0	6,963.0	6,963.0	0.0
DX	101,550	28	116	11.7	6,963.0	6,963.0	6,963.0	0.0
DY	102,026	53	864	5.1	6,967.2	6,967.2	6,967.2	0.0
DZ	102,659	132	356	3.8	6,969.1	6,969.1	6,969.1	0.0
EA	103,398	112	423	3.2	6,970.5	6,970.5	6,970.5	0.0
EB	103,451	27	115	11.8	6,971.0	6,971.0	6,971.0	0.0
EC	103,557	27	245	5.5	6,976.3	6,976.3	6,976.3	0.0
ED	103,926	69	376	3.5	6,977.0	6,977.0	6,977.1	0.1
EE	104,877	38	125	10.4	6,992.4	6,992.4	6,992.4	0.0
EF	106,250	64	287	4.5	7,002.7	7,002.7	7,003.1	0.4
EG	106,989	68	153	8.5	7,008.4	7,008.4	7,008.4	0.0
EH	107,781	33	119	10.9	7,030.6	7,030.6	7,030.6	0.0
EI	108,150	129	315	4.1	7,036.2	7,036.2	7,036.2	0.0

[1] Feet above confluence with San Francisco Wash

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

RIO DE FLAG

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Rio De Flag (Cont'd)								
EJ	108,837	58	145	9.0	7,058.8	7,058.8	7,058.8	0.0
EK	109,347	170	278	4.3	7,086.7	7,086.7	7,086.7	0.0
EL	109,688	127	180	6.7	7,087.1	7,087.1	7,087.1	0.0
EM	109,979	61	288	4.2	7,091.7	7,091.7	7,091.8	0.1
EN	110,677	53	206	5.8	7,099.7	7,099.7	7,099.7	0.0
EO	111,648	39	154	7.8	7,108.3	7,108.3	7,108.3	0.0
EP	111,764	43	281	4.3	7,109.5	7,109.5	7,109.5	0.0
EQ	112,489	63	296	4.1	7,116.1	7,116.1	7,116.2	0.1
ER	112,945	83	318	3.8	7,121.5	7,121.5	7,121.9	0.4
ES	113,177	85	156	7.7	7,125.4	7,125.4	7,125.4	0.0
ET	113,560	75	237	5.1	7,126.9	7,126.9	7,127.2	0.3
EU	113,996	71	287	4.2	7,131.9	7,131.9	7,132.4	0.5
EV	114,589	60	235	5.1	7,142.2	7,142.2	7,142.9	0.7
EW	115,846	37	121	9.1	7,152.7	7,152.7	7,153.2	0.5
EX	115,972	36	178	6.2	7,155.2	7,155.2	7,156.2	1.0
EY	117,134	45	121	9.1	7,165.9	7,165.9	7,166.8	0.9
EZ	118,401	47	159	6.9	7,180.7	7,180.7	7,181.6	0.9
FA	119,668	45	122	9.0	7,211.9	7,211.9	7,212.6	0.7
FB	120,777	50	130	8.4	7,241.8	7,241.8	7,242.6	0.8
FC	121,886	58	146	7.6	7,259.6	7,259.6	7,260.3	0.7
FD	122,942	80	232	4.7	7,269.3	7,269.3	7,270.1	0.8
FE	123,787	50	132	8.4	7,281.6	7,281.6	7,282.2	0.6
FF	125,160	300	631	1.7	7,286.4	7,286.4	7,287.4	1.0
FG	126,057	85	159	6.9	7,288.5	7,288.5	7,289.1	0.6
FH	127,377	121	489	2.3	7,291.6	7,291.6	7,292.6	1.0
FI	128,592	77	197	5.6	7,293.2	7,293.2	7,294.2	1.0
FJ	129,595	145	320	3.4	7,297.3	7,297.3	7,298.2	0.9
FK	130,387	260	678	1.6	7,299.3	7,299.3	7,300.0	0.7

[1] Feet above confluence with San Francisco Wash

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

RIO DE FLAG

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Rio De Flag (Cont'd)								
FL	131,760	250	533	2.1	7,299.9	7,299.9	7,300.9	1.0
FM	134,083	315[2]	479	1.4	7,304.1	7,304.1	7,304.4	0.3
FN	135,456	250	363	1.5	7,304.8	7,304.8	7,305.4	0.6
FO	136,670	200	764	0.7	7,310.2	7,310.2	7,310.8	0.6
FP	137,779	94	63	4.3	7,311.7	7,311.7	7,311.9	0.2
FQ	138,360	24	57	4.8	7,316.2	7,316.2	7,316.8	0.6
FR	138,888	115	452	0.6	7,320.7	7,320.7	7,321.6	0.9
FS	140,155	31	43	6.3	7,333.3	7,333.3	7,333.4	0.1
FT	141,000	61	78	3.5	7,340.9	7,340.9	7,341.1	0.2
FU	142,003	20	36	7.7	7,353.8	7,353.8	7,353.9	0.1
FV	142,620	27	53	5.2	7,361.8	7,361.8	7,361.8	0.0
FW	143,518	14	12	5.5	7,380.2	7,380.2	7,380.2	0.0
FX	144,627	30	18	3.9	7,406.8	7,406.8	7,406.8	0.0
FY	145,735	17	15	4.4	7,427.9	7,427.9	7,427.9	0.0
FZ	146,686	44	19	3.6	7,455.9	7,455.9	7,455.9	0.0

[1] Feet above confluence with San Francisco Wash

[2] Combined Rio de Flag/Baderville Tributary to Rio de Flag Floodway

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

RIO DE FLAG

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Santa Fe Wash East								
A	317	54	168	8.5	6,719.0	6,719.0	6,719.2	0.2
B	686	100	424	3.3	6,721.6	6,721.6	6,721.6	0.0
C	898	150	466	1.8	6,722.0	6,722.0	6,722.0	0.0
D	1,478	141	299	2.8	6,722.2	6,722.2	6,722.4	0.2
E	2,059	166	346	2.4	6,722.9	6,722.9	6,722.9	0.0
F	2,534	63	121	6.9	6,723.5	6,723.5	6,723.5	0.0
G	3,168	69	225	3.7	6,725.6	6,725.6	6,725.6	0.0
H	3,538	150	148	5.7	6,728.2	6,728.2	6,728.2	0.0
I	4,224	455	469	1.8	6,730.3	6,730.3	6,730.3	0.0
J	5,016	285	183	4.2	6,732.9	6,732.9	6,733.4	0.5
K	5,940	183	282	2.5	6,738.4	6,738.4	6,739.3	0.9
L	6,706	50	127	6.0	6,743.6	6,743.6	6,743.9	0.3
M	7,181	97	271	2.8	6,745.5	6,745.5	6,745.5	0.0
N	7,709	50	99	7.8	6,747.4	6,747.4	6,747.7	0.3
O	7,814	80	356	2.2	6,752.5	6,752.5	6,752.9	0.4
P	8,659	32	84	9.2	6,756.4	6,756.4	6,756.8	0.4
Q	9,715	66	133	5.8	6,768.3	6,768.3	6,768.8	0.5
R	10,402	42	62	6.8	6,775.5	6,775.5	6,775.7	0.2
S	10,613	40	91	4.6	6,778.9	6,778.9	6,778.9	0.0

[1] Feet above confluence with Cataract Creek

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

SANTA FE WASH EAST

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Santa Fe Wash West								
A	158	84	197	3.6	6,721.7	6,721.7	6,721.7	0.0
B	686	232	371	1.9	6,722.8	6,722.8	6,722.8	0.0
C	1,109	170	167	4.2	6,724.0	6,724.0	6,724.0	0.0
D	1,373	65	131	5.4	6,725.0	6,725.0	6,725.1	0.1
E	1,795	62	148	4.8	6,726.4	6,726.4	6,726.4	0.0
F	2,165	78	281	2.5	6,727.3	6,727.3	6,727.4	0.1
G	2,851	274	328	2.2	6,730.5	6,730.5	6,730.5	0.0
H	3,590	134	132	5.3	6,733.5	6,733.5	6,733.5	0.0
I	4,066	214	278	2.6	6,735.9	6,735.9	6,735.9	0.0
J	4,382	500	1,580	0.4	6,740.4	6,740.4	6,740.5	0.1
K	5,333	240	163	3.9	6,742.1	6,742.1	6,742.1	0.0
L	5,914	295	229	2.8	6,747.5	6,747.5	6,747.5	0.0
M	6,225	123	125	5.1	6,750.3	6,750.3	6,750.3	0.0
N	6,442	30	146	4.1	6,757.0	6,757.0	6,757.0	0.0
O	7,075	55	236	1.4	6,757.5	6,757.5	6,758.1	0.6
P	7,814	20	28	6.8	6,762.5	6,762.5	6,763.4	0.9
Q	8,237	51	91	2.1	6,765.3	6,765.3	6,766.3	1.0

[1] Feet above confluence with Santa Fe Wash East

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

SANTA FE WASH WEST

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Schultz Creek								
A	2,033	103	190	2.3	7,006.1	7,006.1	7,006.3	0.2
B	2,135	25	120	3.7	7,006.3	7,006.3	7,006.5	0.2
C	2,230	64	205	2.1	7,006.6	7,006.6	7,006.8	0.2
D	2,244	47	159	2.8	7,006.6	7,006.6	7,006.8	0.2
E	2,270	44	145	3.0	7,006.6	7,006.6	7,006.8	0.2
F	2,296	40	62	7.1	7,007.0	7,007.0	7,007.0	0.0
G	2,588	57	165	2.7	7,009.1	7,009.1	7,009.1	0.0
H	2,824	64	88	5.0	7,010.1	7,010.1	7,010.1	0.0
I	3,021	50	76	5.8	7,014.6	7,014.6	7,014.7	0.1
J	3,345	30	60	7.3	7,028.4	7,028.4	7,028.4	0.0
K	3,648	43	79	5.6	7,036.7	7,036.7	7,036.7	0.0
L	3,695	67	87	5.1	7,038.4	7,038.4	7,038.4	0.0
M	3,918	57	84	5.2	7,045.6	7,045.6	7,045.6	0.0
N	3,968	69	90	4.9	7,046.8	7,046.8	7,046.8	0.0
O	3,996	23	90	4.9	7,047.3	7,047.3	7,047.3	0.0
P	4,033	26	127	3.5	7,048.6	7,048.6	7,048.6	0.0
Q	4,047	51	64	6.9	7,048.5	7,048.5	7,048.5	0.0
R	4,167	59	84	5.3	7,052.8	7,052.8	7,052.8	0.0
S	4,468	40	59	7.4	7,063.7	7,063.7	7,063.7	0.0
T	4,521	82	92	4.8	7,065.2	7,065.2	7,065.2	0.0
U	4,539	20	54	8.2	7,065.2	7,065.2	7,065.2	0.0
V	4,568	15	99	4.4	7,069.5	7,069.5	7,069.5	0.0
W	4,584	38	142	3.1	7,069.9	7,069.9	7,069.9	0.0
X	4,655	20	50	8.8	7,069.6	7,069.6	7,069.6	0.0
Y	5,082	14	44	10.1	7,084.5	7,084.5	7,084.6	0.1
Z	5,344	21	49	9.1	7,092.6	7,092.6	7,092.6	0.0
AA	5,636	99	84	5.2	7,100.9	7,100.9	7,100.9	0.0
AB	5,861	32	64	6.9	7,104.7	7,104.7	7,104.9	0.2

[1] Feet above confluence with Rio de Flag

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

SCHULTZ CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Schultz Creek (Cont'd)								
AC	6,054	62	64	6.9	7,109.0	7,109.0	7,109.0	0.0
AD	6,418	43	71	6.2	7,115.2	7,115.2	7,115.2	0.0
AE	6,654	58	65	6.8	7,119.0	7,119.0	7,119.0	0.0
AF	7,118	56	73	6.1	7,127.5	7,127.5	7,127.5	0.0
AG	7,334	61	67	6.6	7,131.8	7,131.8	7,131.8	0.0
AH	7,482	22	51	8.6	7,134.1	7,134.1	7,134.2	0.1
AI	7,672	41	62	7.1	7,139.8	7,139.8	7,139.8	0.0

[1] Feet above confluence with Rio de Flag

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

SCHULTZ CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Sinclair Wash								
A	211	59	103	6.9	6,854.5	6,854.5	6,854.7	0.2
B	370	75	758	1.2	6,855.1	6,855.1	6,855.5	0.4
C	845	75	646	1.4	6,855.1	6,855.1	6,855.5	0.4
D	1,584	63	523	1.7	6,855.2	6,855.2	6,855.6	0.4
E	2,693	55	257	3.5	6,855.3	6,855.3	6,855.8	0.5
F	2,851	21	115	7.7	6,855.6	6,855.6	6,855.9	0.3
G	3,010	55	302	2.9	6,856.8	6,856.8	6,856.9	0.1
H	3,643	25	96	9.3	6,856.8	6,856.8	6,856.9	0.1
I	4,541	29	138	6.4	6,861.1	6,861.1	6,861.6	0.5
J	4,699	21	81	11.0	6,863.0	6,863.0	6,863.0	0.0
K	4,752	21	106	8.4	6,864.4	6,864.4	6,864.4	0.0
L	4,805	26	125	7.1	6,864.4	6,864.4	6,864.4	0.0
M	5,702	21	123	7.3	6,865.6	6,865.6	6,866.3	0.7
N	8,237	49	130	5.7	6,877.2	6,877.2	6,877.3	0.1
O	8,290	49	188	4.1	6,877.3	6,877.3	6,877.7	0.4
P	8,976	31	88	6.2	6,879.9	6,879.9	6,880.2	0.3
Q	9,134	37	274	2.0	6,885.9	6,885.9	6,885.9	0.0
R	10,032	48	135	4.1	6,886.2	6,886.2	6,886.3	0.1
S	10,718	31	97	5.7	6,888.6	6,888.6	6,888.6	0.0
T	10,930	134	636	0.9	6,894.2	6,894.2	6,895.2	1.0
U	12,514	33	67	8.2	6,900.0	6,900.0	6,900.0	0.0
V	13,517	45	137	4.0	6,904.9	6,904.9	6,905.9	0.1
W	13,992	30	67	7.0	6,908.4	6,908.4	6,908.5	0.1
X	14,203	47	246	1.9	6,909.0	6,909.0	6,909.7	0.7
Y	14,573	66	418	1.1	6,913.7	6,913.7	6,914.7	1.0
Z	14,784	95	433	1.1	6,913.7	6,913.7	6,914.7	1.0
AA	14,890	112	362	1.3	6,913.9	6,913.9	6,914.7	0.8
AB	15,576	51	129	3.6	6,913.9	6,913.9	6,914.9	1.0

[1] Feet above confluence With Rio de Flag

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

SINCLAIR WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Sinclair Wash (Cont'd)								
AC	17,530[1]	50	61	6.1	6,930.6	6,930.6	6,930.6	0.0
AD	19,378[1]	50	95	3.9	6,944.4	6,944.4	6,945.2	0.8
AE	21,067[1]	44	54	5.0	6,955.9	6,955.9	6,955.9	0.0
Soldier Wash								
A	634[2]	96	201	8.5	4,193.3	4,193.3	4,194.1	0.8
B	834[2]	76	190	9.1	4,196.1	4,196.1	4,197.0	0.9
C	1,056[2]	96	195	8.8	4,201.2	4,201.2	4,201.2	0.0
D	1,542[2]	25	174	9.9	4,208.2	4,208.2	4,208.3	0.1
E	1,795[2]	33	328	5.2	4,214.3	4,214.3	4,215.0	0.7
F	2,091[2]	33	210	8.2	4,216.6	4,216.6	4,217.5	0.9
G	2,270[2]	42	303	5.7	4,223.5	4,223.5	4,223.5	0.0
H	2,904[2]	59	174	9.9	4,227.9	4,227.9	4,227.9	0.0
Spruce Avenue Wash								
A	1,478	27	88	6.6	6,819.5	6,819.5	6,820.4	0.9
B	1,760	35	138	4.2	6,826.5	6,826.5	6,826.5	0.0
C	2,165	63	101	5.7	6,830.9	6,830.9	6,830.9	0.0
D	2,452	59	143	4.0	6,832.8	6,832.8	6,832.8	0.0
E-AB*								

[1] Feet above confluence with Rio de Flag

[2] Feet above confluence with Oak Creek

* Floodway not computed

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

SINCLAIR WASH – SOLDIER WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Switzer Canyon Wash								
A	370	133	413	1.9	6,788.8	6,788.7[2]	6,789.5	0.8
B	792	234	1,115	0.7	6,788.8	6,788.8	6,789.7	0.9
C	1,109	224	850	0.9	6,788.8	6,788.8	6,789.7	0.9
D	1,373	83	253	3.1	6,788.9	6,788.9	6,789.7	0.8
E	2,059	70	188	4.2	6,790.4	6,790.4	6,791.1	0.7
F	2,851	44	163	4.9	6,792.9	6,792.9	6,793.8	0.9
G	3,590	36	138	5.7	6,796.4	6,796.4	6,797.4	1.0
H	4,382	54	222	3.6	6,799.2	6,799.2	6,800.2	1.0
I	4,858	44	178	4.5	6,800.3	6,800.3	6,801.2	0.9
J	5,755	54	185	4.3	6,803.3	6,803.3	6,804.1	0.8
K	6,072	20	50	6.9	6,804.8	6,804.8	6,805.3	0.5
L	6,494	21	37	9.2	6,810.7	6,810.7	6,811.5	0.8
M	6,758	22	43	8.0	6,826.1	6,826.1	6,826.2	0.1
N	7,128	30	47	7.3	6,837.1	6,837.1	6,837.8	0.7
O	7,656	38	96	3.6	6,840.4	6,840.4	6,841.1	0.7
P	7,709	104	256	1.3	6,842.4	6,842.4	6,843.4	1.0
Q	7,973	87	292	1.2	6,842.4	6,842.4	6,843.4	1.0
R	8,712	52	97	3.6	6,843.1	6,843.1	6,843.7	0.6
S	9,451	51	60	5.7	6,848.8	6,848.8	6,848.8	0.0
T	9,827	67	148	2.3	6,850.2	6,850.2	6,850.2	0.0
U	9,984	19	41	8.4	6,852.5	6,852.5	6,852.5	0.0
V	10,238	27	73	4.7	6,854.6	6,854.6	6,854.6	0.0
W	10,404	26	83	4.2	6,855.2	6,855.2	6,855.2	0.0
X	10,510	26	73	4.7	6,855.4	6,855.4	6,855.4	0.0
Y	10,618	22	63	5.5	6,855.7	6,855.7	6,855.7	0.0
Z	10,967	29	92	3.8	6,856.5	6,856.5	6,856.5	0.0
AA	11,315	17	79	4.4	6,857.5	6,857.5	6,857.5	0.0
AB	11,378	29	90	2.0	6,857.8	6,857.8	6,857.8	0.0

[1] Feet above confluence with Rio de Flag

[2] Elevation computed without consideration of backwater effects from Rio de Flag

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

SWITZER CANYON WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Switzer Canyon Wash (Cont'd)								
AC	11,553	365	727	0.4	6,857.9	6,857.9	6,857.9	0.0
AD	11,669	299	331	1.1	6,858.0	6,858.0	6,858.0	0.0
AE	11,759	188	179	1.9	6,860.2	6,860.2	6,860.2	0.0
AF	12,883	27	159	1.6	6,868.6	6,868.6	6,869.0	0.4
AG	12,939	65	237	1.1	6,868.6	6,868.6	6,869.0	0.4
AH	13,165	58	168	1.5	6,868.8	6,868.8	6,869.2	0.4
AI	13,334	54	124	2.0	6,869.0	6,869.0	6,869.3	0.3
AJ	13,770	58	73	3.4	6,870.5	6,870.5	6,870.6	0.1
AK	13,827	54	173	1.4	6,870.8	6,870.8	6,870.9	0.1
AL	13,896	54	134	1.9	6,871.6	6,871.6	6,871.8	0.2
AM	13,940	29	118	2.1	6,871.7	6,871.7	6,871.9	0.2
AN	14,383	54	124	2.0	6,872.2	6,872.2	6,872.4	0.2
AO	14,778	98	164	1.5	6,872.9	6,872.9	6,873.0	0.1
AP	15,193	66	82	3.0	6,873.7	6,873.7	6,873.7	0.0
AQ	15,475	68	85	2.9	6,875.0	6,875.0	6,875.0	0.0
AR	15,679	90	61	4.1	6,876.5	6,876.5	6,876.5	0.0
AS	15,738	47	101	2.5	6,877.0	6,877.0	6,877.0	0.0
AT	15,849	48	31	8.0	6,877.6	6,877.6	6,877.6	0.0
AU	15,967	39	104	2.4	6,881.9	6,881.9	6,881.9	0.0
AV	16,044	49	91	2.8	6,882.4	6,882.4	6,882.4	0.0
AW	16,252	51	76	3.3	6,884.6	6,884.6	6,884.7	0.1
AX	16,693	90	95	2.6	6,891.1	6,891.1	6,891.4	0.3
AY	17,243	39	60	4.2	6,902.0	6,902.0	6,902.3	0.3
AZ	17,741	30	65	3.9	6,911.3	6,911.3	6,911.3	0.0
BA	18,174	48	46	5.4	6,921.7	6,921.7	6,921.9	0.2
BB	18,595	45	74	3.4	6,931.4	6,931.4	6,931.4	0.0
BC	19,012	30	39	6.4	6,942.9	6,942.9	6,942.9	0.0
BD	19,379	71	110	2.3	6,950.1	6,950.1	6,950.1	0.0

[1] Feet above confluence with Rio de Flag

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

SWITZER CANYON WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Switzer Canyon Wash (Cont'd)								
BE	19,512	50	42	5.9	6,953.0	6,953.0	6,953.0	0.0
BF	19,702	69	99	2.5	6,958.0	6,958.0	6,958.0	0.0
BG	19,786	15	32	7.8	6,963.3	6,963.3	6,963.3	0.0
BH	19,981	24	111	2.2	6,967.0	6,967.0	6,967.0	0.0
BI	20,039	46	159	1.6	6,967.1	6,967.1	6,967.1	0.0
BJ	20,171	26	34	7.4	6,968.0	6,968.0	6,968.0	0.0
BK	20,380	33	68	3.7	6,972.5	6,972.5	6,972.5	0.0
BL	20,404	16	38	6.5	6,972.6	6,972.6	6,972.6	0.0
BM	20,440	14	70	3.6	6,975.2	6,975.2	6,976.0	0.8
BN	20,524	37	95	2.6	6,975.6	6,975.6	6,976.5	0.9
BO	20,567	28	95	2.6	6,976.0	6,976.0	6,976.6	0.6
BP	20,601	21	37	6.8	6,976.7	6,976.7	6,976.8	0.1
BQ	20,709	60	225	1.1	6,982.8	6,982.8	6,983.5	0.7
BR	20,741	33	138	1.8	6,982.8	6,982.8	6,983.5	0.7
BS	20,799	50	137	1.8	6,982.8	6,982.8	6,983.5	0.7
BT	21,066	20	76	3.3	6,983.3	6,983.3	6,983.7	0.4
BU	21,146	40	172	1.5	6,985.1	6,985.1	6,985.8	0.7
BV	21,241	95	372	0.7	6,985.2	6,985.2	6,985.9	0.7
BW	21,317	74	186	1.3	6,985.2	6,985.2	6,985.9	0.7
BX	21,404	115	463	0.5	6,988.0	6,988.0	6,988.7	0.7
BY	21,620	149	242	1.0	6,988.0	6,988.0	6,988.7	0.7
BZ	21,887	92	38	4.0	6,990.6	6,990.6	6,990.6	0.0
CA	22,293	71	74	2.0	6,994.1	6,994.1	6,994.5	0.4
CB	22,557	81	37	4.0	6,997.6	6,997.6	6,997.6	0.0
CC	22,645	85	74	2.0	6,999.2	6,999.2	6,999.3	0.1
CD	22,939	23	26	5.9	7,004.4	7,004.4	7,004.4	0.0
CE	23,171	39	60	2.5	7,006.0	7,006.0	7,006.3	0.3
CF	23,446	50	62	2.4	7,006.7	7,006.7	7,007.2	0.5

[1] Feet above confluence with Rio de Flag

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

SWITZER CANYON WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Switzer Canyon Wash (Cont'd)								
CG	23,772	49	36	4.2	7,008.7	7,008.7	7,009.2	0.5
CH	24,297	110	78	1.9	7,013.4	7,013.4	7,013.4	0.0
CI	24,742	75	68	2.2	7,016.2	7,016.2	7,016.2	0.0
CJ	25,235	49	52	2.9	7,020.0	7,020.0	7,020.1	0.1
CK	25,716	90	71	2.1	7,024.1	7,024.1	7,024.1	0.0
CL	26,174	129	81	1.8	7,027.2	7,027.2	7,027.2	0.0
CM	26,547	128	79	1.9	7,030.0	7,030.0	7,030.0	0.0

[1] Feet above confluence with Rio de Flag

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

SWITZER CANYON WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Tributary 1 to Baderville Tributary								
A	735	36	50	3.2	7,313.8	7,313.8	7,314.8	1.0
B	1410	29	41	4.0	7,318.5	7,318.5	7,319.2	0.7
C	2,105	35	49	3.3	7,322.9	7,322.9	7,323.9	1.0
D	2,475	25	37	4.3	7,325.9	7,325.9	7,326.5	0.6
Tributary 2 To Baderville Tributary								
A	685	24	37	2.0	7,321.4	7,321.4	7,322.4	1.0
B	1430	22	23	3.2	7,324.5	7,324.5	7,325.3	0.8

[1] Feet above confluence with Baderville Tributary to Rio de Flag

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

TRIBUTARY 1 TO BADERVILLE TRIBUTARY – TRIBUTARY 2 TO BADERVILLE TRIBUTARY

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Unnamed Wash								
A	1,070	10	27	5.1	6,905.1	6,905.1	6,906.1	1.0
B	1,695	57	82	1.7	6,910.4	6,910.4	6,910.5	0.1
C	2,100	104	205	0.7	6,910.6	6,910.6	6,910.7	0.1
D	2,530	56	40	3.5	6,911.2	6,911.2	6,911.5	0.3
E	2,835	64	61	2.3	6,914.0	6,914.0	6,914.2	0.2
F	3,220	22	49	2.9	6,917.0	6,917.0	6,917.8	0.8

[1] Feet above Lake Mary Road

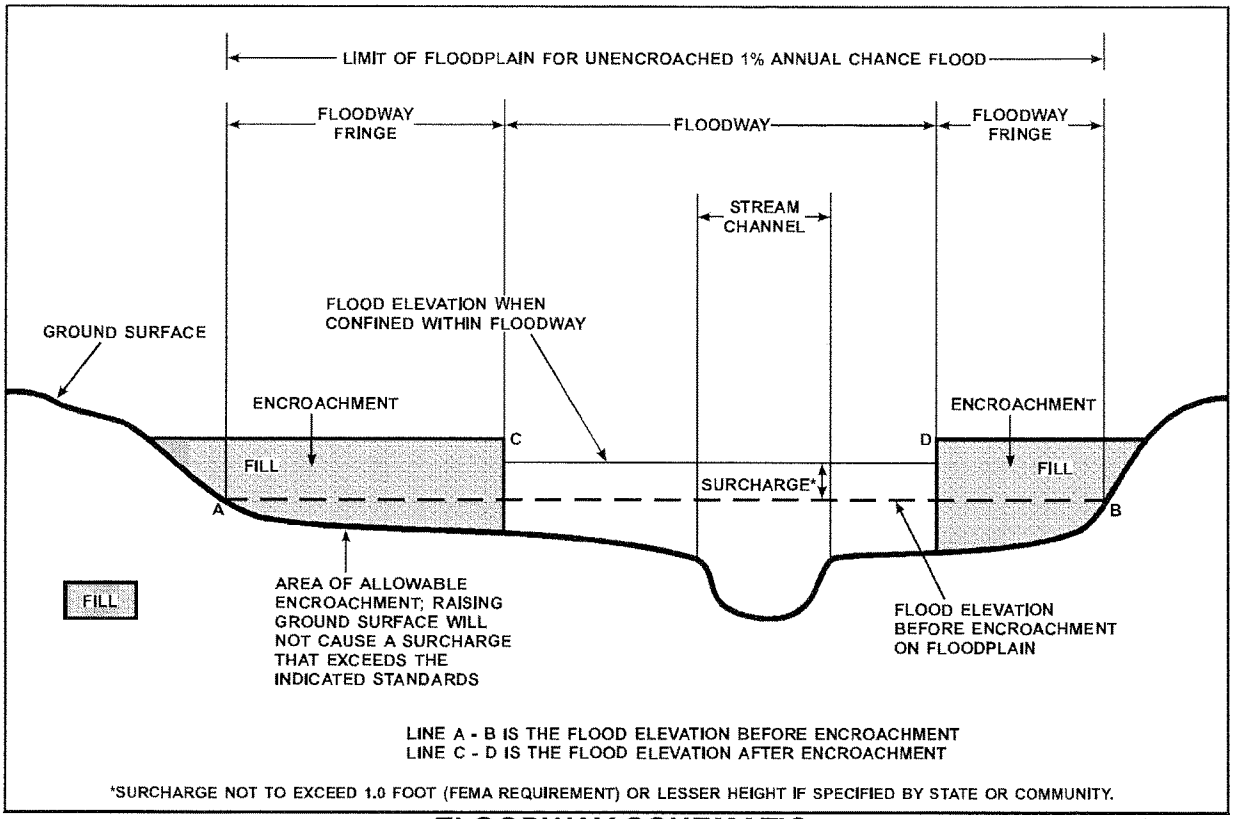
TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COCONINO COUNTY, AZ AND INCORPORATED AREAS

FLOODWAY DATA

UNNAMED WASH



FLOODWAY SCHEMATIC Figure 1

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 1-percent annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at sclectcd intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 1-percent annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone AR

Area of special flood hazard formerly protected from the 1-percent annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1-percent annual chance or greater flood event.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 1-percent annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent annual chance floodplain, areas within the 0.2-percent annual chance floodplain, and to areas of 1-percent annual chance flooding where average depths are less than 1 foot, areas of 1-percent annual chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-

percent annual chance flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 1-percent annual chance floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent annual chance floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

The current FIRM presents flooding information for the entire geographic area of Coconino County. Previously, separate Flood Hazard Boundary Maps and/or FIRMs were prepared for each identified flood-prone incorporated community and the unincorporated areas of the county. This countywide FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical data relating to the maps prepared for each community are presented in Table 10, "Community Map History."

7.0 OTHER STUDIES

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Coconino County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS Reports, FHBMs, FBFMs, and FIRMs for all of the incorporated and unincorporated jurisdictions within Coconino County.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this FIS can be obtained by contacting FEMA, Federal Insurance and Mitigation Division, 1111 Broadway, Suite 1200, Oakland, California 94607-4052.

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